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ELECTRICITY A GENERATION AGO.

With the present issue the ELECTRICAL WORLD enters on the second generation of existence, having been founded as *The Operator* March 1, 1874. At that date telegraphy stood almost alone for electrical application. Aside from it the only industry worth mentioning depending upon electricity was that of electrodeposition, and this was only then beginning to add nickel to silver plating. Moreover, telegraphy in 1874 had reached a stage as an art differing little from that of to-day. Indeed, machine telegraphy had at that time a better status than at any subsequent period up to a few years ago. The cause of this halt in telegraphic development appears to be two-fold. The first and greatest was perhaps the elimination of competition, which is always accompanied by a tendency to "standardization" and the maintenance of conditions which produce satisfactory dividends, however antiquated these conditions in time become. In the second place, the beginning of the great modern era of electrical development a quarter of a century ago, created a demand for men with some electrical knowledge, which drew from the younger element in the telegraphic field its ablest representatives; and since then the greater opportunities in the newer branches of electrical application have served to divert from that field the bright and energetic minds which formerly recruited it. Again, inventive and engineering thought found new opportunities vastly more enticing than those incident to telegraphy, while the market for inventions in these lines was eagerly receptive and lavishly generous.

It is an interesting fact that the year 1874 was just as qualified, with a few exceptions, to usher in the new electrical era as the beginning of several succeeding periods identified with notable electrical development. The direct-current dynamo in the Gramme ring and Siemens drum types was available for general commercial application. The alternating-current machine was in practical use for lighthouse illumination. The arc lamp had long been in condition for commercial application. Planté had communicated to the world the results of his more important investigations of the storage battery. The electric motor was in state for commercial development and through it the electric railway could quickly have been realized. The principles of the transformer were awaiting extension from the Ruhmkorff coil to the lighting apparatus. In fact, the telephone, polyphase motor and wireless telegraph stand almost alone as the radical invention of the succeeding periods. The incandescent lamp is not included with the exceptions, for the reason that the development of arc lighting about 1876 brought an irresistible demand for a smaller unit of electric light, and the prior work of Starr and Chanzy and others so clearly pointed the way to realization that if the problem had been taken up in 1874 it would have been as readily solved as in 1879. Similarly, it was such a slight step from the Planté to the pasted plate that it could have been covered as well at the

earlier as the later date. These considerations point to the several steps incident to any radical development. The first is the greatest—the discovery of the fundamental principle by a Volta, Faraday or Bell. The second is the connection of this principle with utilitarian use by a Davy, Planté or Paccinotti. The third is the application to specific use, the period of technical invention. The final and usually most difficult step is the commercial one of exploitation, the enlistment of the power of money. Little or no monetary reward goes to those who figure in the first two stages and frequently entirely inadequate reward to those of the third stage. Yet the world to-day is indebted at least as much to those working prior to 1874 who laid the foundations of electrical development, as to those in the generation just closing who built on these foundations, and have participated in the returns from commercial exploitation.

Harnessing the Susquehanna.

The York Haven plant, described in the present issue, is a type of the big developments for general distribution which are now becoming common. The Susquehanna is a stream of great possibilities as yet only partly developed, for it carries a huge volume of water and its descent near tide water where this plant is located is rapid. It would probably have been brought into use long ere this save for the rather formidable hydraulic work necessary and for a certain fear of freshets which experience has now partly dispelled. The situation of the plant is a fortunate one, since it is within immediate striking range of a very large market at the voltages now common. The plant in its main equipment is in line with recent practice, but it has some special peculiarities to which rather than to routine detail we would direct attention. The most unusual feature of the plant is the very notable deviation from usual practice in the arrangement of the turbines. The available head at this point is low, a little over 20 ft. at normal stages of the water, and there was some liability of flood to be considered. Hence came the use of vertical turbines, each pair driving a single generator through the medium of bevel gears. The head is too low to admit a generator of reasonably large capacity carried directly upon the vertical turbine shaft, hence two turbines are geared to a single generator on a horizontal axis. This arrangement is following old-time mill practice and it looks very queer indeed at first sight. Yet there seems to be a certain logical pressure of circumstances which led directly to the result. A low head, a huge power and possible floods make a bad combination to beat, and whichever way of escape be taken one generally wishes he had selected some other.

The second unusual construction is found in the crossing of the Susquehanna River by means of high-tension cables laid in the river bed in lieu of making a long span. The distance is some 3,500 ft., and while this distance is perfectly manageable as the line across Carquinez Straits shows, it still involves the use of a costly structure at each side of the stream. The alternative of cables would a few years ago have seemed almost impossible, but cable manufacture has improved, and while the way taken out of the dilemma seems even now rather hazardous, it may prove successful and certainly saves in first cost. Cables even under water can be made to give good service, although there is still an element of luck in the life which may be expected from them, and when one fails the loss is considerable. Like most recent big stations, this plant does, and probably will do, mainly a wholesale business, distributing its power through existing companies. This can be generally done, as it is in this instance, at fairly remunerative prices, and has the great advantage of simplifying the franchise question and the general work of administration. In large plants working at high voltage over a great territory, wholesaling power has come to be rather the rule than the exception, and it generally works well for both parties. To the power plant it assures a regular and certain income, and to the distributing plant it gives a very favorable cost of energy at the switchboard. In the case in hand the territory covered has plenty of distributing plants available, and these with the valuable manufacturing sites near at hand should ensure the plant a full load.

The Secretary of War's Decision on Niagara Falls.

The conflict of opinion and the battle of demand for harnessing Niagara into horse-power on the one hand, and for leaving the falls to fall on in undisturbed precipitation on the other, became so desperate that the head of the United States War Department had to be called in to settle the dispute. One side shouted for power and to the dynamos belong the spoils. The other side shouted for scenic beauty, and over with the falls. The Secretary has thrown oil on the ruffled cataract, and has endeavored to do justice to both sides of the dispute, as well as to both sides of Niagara. His decision settles the question of work versus beauty for three years. He gives a permit for taking 15,600 cu. ft. of water per second on the American side, and also for the transmission of 160,000 hp from the Canadian side to the United States. Every year that passes points out the great utilitarian value of the power that is being drawn from Niagara through the medium of electricity, and also the enormous potential utilitarian value of the power that is being wasted in the Niagara Falls and rapids. Whole industries have come into existence around the cataract, and a large city has grown up in a few years, as the result of the application of the power. At the same time, the grandeur of the cataract as a scene is of world-wide notoriety. It lies with the people of the North American continent to decide, in the future, whether they will prefer to keep Niagara as a scene of wild grandeur and a national ornament, or whether they will use the power and forego, at least, a part of the ornament. It would be perfectly proper to decide on keeping the ornament, provided that the cost is clearly understood. If, for example, we take the available remaining power of the falls as, say, four millions of horse-power net, and reckon the average value of this power as, say, ten dollars per horse-power-year to the people, over and above the cost of harnessing, then the retention of the ornament would ultimately be worth forty millions of dollars per annum to the country. That would be so expensive an ornament that it is doubtful whether, within the next hundred years, the economic force of the argument can be withheld. For the present we can rest content with what has already been accomplished. Moreover, in times to come, it might be possible for engineers and landscape architects so to design the hydraulic works that all the power of Niagara could be completely utilized twenty-three hours, daily, and during the noon-hour, nearly all of the water could be released over the dam for the benefit of visitors, without destroying the beauty of the cataract.

THE ADVANCE OF THE METRIC SYSTEM.

The Committee on Coinage, Weights and Measures of the House of Representatives has recently published a volume of 272 printed pages containing testimony heard both for and against the Littauer Metric System Bill of the Fifty-ninth Congress. There are no new arguments on either side, and the committee by a small majority decided not to report the bill to Congress. Meanwhile, however, the metric system is steadily increasing in use in English-speaking countries. More books are being printed in that system, and frequent metric descriptions appear in the daily press without comment or estimated need for interpretation. In England one prominent manufacturing firm, "Kynoch's, Ltd.", has voluntarily adopted the metric system in its own works for economy and convenience. The Decimal Association reports that a recent canvass of members of the House of Commons shows a majority of 148 in favor of the metric system. The attempt of the British Weights and Measures Association to create favor for a new decimal system based on the English inch does not seem to have been at all successful, even in England. It may not be generally known that the United States and its people are already on a metric system basis, as regards outgoing mails to foreign countries in the Postal Union. A letter mailed, for example, to Italy, from any part of the United States, if overweight, is taxed at the port of exit, usually New York, on the basis of five cents for 15 grammes, or part in excess thereof, and not on the basis of five cents for half an ounce, which is only 14.175 grammes, or nearly 6 per cent less. Consequently, Americans may send letters abroad nearly 6 per cent heavier than they usually suppose without extra cost. The same condition exists in Great Britain. The fact that the Post Office is able to operate the metric system in all its foreign departments without any trouble should satisfy any fair-minded individual that there is no difficulty in using the metric system in a large business.

THE ARTISTIC LIGHTING OF BUSINESS STREETS.

We have frequently during the past year noted the efforts being made in various cities toward more uniform and artistic lighting of the down-town business streets, either with the use of handsome lamp-posts along each side of the street or by arches and festoons of incandescent lamps. There are several things both for the central station company and the down-town merchant to consider in connection with such movements. It must be granted at the outset that the proper lighting of a business thoroughfare by lamps placed at frequent intervals is a desirable thing for any city to have, and that a certain amount of money should be expended on such lighting. The point to which has been given too little attention in the past is the effect of such lighting on whatever display there may be in the store windows along the street. Looking at the matter from the standpoint of the purely selfish merchant, there would seem to be little doubt that money spent in individual sign and show-window lighting and even in the illumination of the interior of the store when it is not open, is a better advertisement than illumination of the street on which the store fronts. If the store and its windows are brilliantly illuminated, the street will usually be well illuminated also. Nevertheless, it takes something more than a few well-lighted show-windows and stores to make a street an attractive place at night; hence the importance of a general movement for street lighting in addition to the individual efforts of each merchant to light his own premises.

It must not be forgotten, however, in planning a street illumination, that the presence of a lot of large arc lamps at the curb-line in front of stores detracts very much from the advertising value of a good show-window or well-lighted store interior as viewed from across the street. The old method of hanging arc lamps in front of a store for advertising purposes is seldom employed now by progressive merchants for the reason that they are not advertising electric light, but merchandise. They cannot display merchandise to advantage with glaring arc lamps in the line of vision, making the illumination in the store and in the windows seem insignificant by contrast. It is well, therefore, both in the interests of the merchant and the central station company which is to sell the electricity that the scheme of special illumination used on the down-town streets be not so glaring as to interfere with the illuminating effects sought by individual merchants.

There is such a thing as carrying the street illumination too far; and those about to inaugurate special down-town lighting will do well to consider just where to draw the line. Much more illumination can be used on a street if the sources of light are not of great intrinsic brilliancy than if they are dazzling like the arc lamps with clear globes used in some cities. Indeed, it is a question whether, in the present state of the art, the ordinary carbon arc lamp is entitled to consideration at all for special artistic lighting of the business streets. The arc, when put in sufficiently dense enclosing globes to diffuse the light to a point where it is tolerable for artistic street lighting, has an efficiency little, if any, better than the newer types of incandescent lamps obtainable on the market to-day equipped with the proper diffusing globes. Adding to this the fact that the tungsten incandescent lamp of still better efficiency is practically a certainty in the near future and that other high-efficiency filaments are on the horizon, it would seem to be unwise to put in a system involving the high maintenance and first cost of the present carbon arc lamp. In designing lamp-posts for incandescent lighting, provision should be made for the future use of single large high-efficiency incandescent lamps rather than for clusters of the present small low efficiency lamps. The larger incandescent lamps will probably for some time to come be of considerably better life and efficiency than the small lamps.

ADVERTISING HOLDS CUSTOMERS.

Considerable has been said about the maintenance of soliciting departments and the value of advertising to obtain new customers, but perhaps insufficient attention has been given to the value of these things in retaining old customers and in increasing their use of electricity. On every company's lines there are a certain number of customers who, after the novelty of a new kind of service is worn off, are likely to change over to any other new proposition that happens to strike their fancy, and it is right here that advertising has a value in retaining the interest and pride of such customers in their existing electric light or power service. If they know that a service is being talked about continually in advertisements addressed to those who

are not customers, it is quite natural for them to feel some pride in already having these conveniences and in making the full use of them. What is being talked about in advertisements and by solicitors will be talked about by the readers of those advertisements, and when these matters are talked about by the general public the users of them are tolerably certain to think about them as things of value, and not only to retain their own service, but tell others about the advantages—provided, of course, that the service is what it should be.

Electric Cooking Data.

We have several times recently urged the advisability of central station men obtaining practical experience with electric cooking in order to be ready to handle the matter intelligently when the time comes to push it among customers. Everything which helps to a familiarity with electric cooking in the common every-day life of an ordinary family is a step ahead. On account of the general interest displayed by our many central station friends, in the results of practical trials of this kind, and because of the complaint that many of the tests so far published have been very incomplete as to particulars or from supposedly prejudicial sources (the manufacturers . we give considerable space this issue to the record of a month's electric cooking in the family of one of our editorial staff and other matters of interest in connection with it. This we hope to follow soon with the experience of a number of others in order to bring out practical and specific points on a subject about which there has been considerable generalizing, some of it correct and some otherwise. As to kw-hour consumption, the present test checks up very closely with the previous experience, viz., that one-third of a kw-hour per meal per person is a fair average figure to assume for electric cooking in families of from 3 to 5. The maximum demand of a cooking equipment has a decided influence on the necessary transformer and meter capacity, though not likely to have much on required station capacity in small towns. In large cities, however, it is chargeable with considerable increased station capacity over and above the lighting and power load. Of advantages it has a considerable array, some of which have not been heretofore sufficiently enlarged upon.

Special Offers to Create Business.

It would be very interesting were it possible to obtain accurate statistics of the results of all the special offers to create business which have been made by central station companies in the past few years. By special offers we mean, for example, offers to wire residences free for a limited period with a certain specified number of lamps; or the offer of a reduction in bills to cover part of the expense of wiring, and many other schemes which are in general on the same order as the "bargain-day sales" offered by department stores. There is much to be said on both sides of this question of special offers. On one hand, it can be claimed that they tend to demoralize the regular business and to create an impression that there is an undue amount of profit in ordinary legitimate work if a company can afford to make such sweeping reduction, even for a short time. It may be argued that it is better to spend the amount of money that is lost on these special offers in an extra amount of soliciting and advertising to get in this same business at regular rates. On the other hand, there are always some people who are looking for the "bargain-day sales" and who can best be reached in this way. There is considerable difference in local conditions in this respect. In some towns where, for example, residence lighting has made but little progress and it seems very difficult for the central station company to lay a foundation for a decided increase in its residence business, it may be necessary to start the ball rolling in some such way with temporary special offers. We have known of one or two cases where temporary offers to have houses wired free resulted in a very large number of connections within a short time, but, of course, it was expensive business for the company. On the whole, it will probably seem to be better to formulate a certain inexpensive wiring proposition good the year around. While it may be found in most cases that the residence owner, when he actually has his house wired, wishes something considerably better than the low-priced job offered at the very low rate, the offer is the means of getting him interested, in the first place.

Small Central Station Financing.

The smaller central stations of this country have, as a general rule, been built by local capital. The local stockholders have usually gone into the enterprise with the idea that it would take a certain amount of money to build the plant and that would settle the entire question of finances. No account was, as a rule, taken of the fact that business would grow continually if the service was anywhere near satisfactory and that to enlarge the plant to take care of this business more capital would soon be necessary. Each year the company would earn considerably more than its operating expenses, but this money would be put back into the property in the shape of improvements and extensions. This process has gone along gradually year after year in almost every small central station until after ten or twenty years' growth the company finds itself with a very much larger property than it had at the beginning, but with one which has apparently never paid much in the way of dividends. Then, too, the depreciation due to advances in the art has been at times very great, but on the whole, the smaller central stations have literally worn out the older apparatus rather than make the heavy sacrifice that the throwing it out and substituting something more modern would involve. It could, therefore, hardly be considered that depreciation due to advances in the art has played a very important part under such circumstances. In some cases the smaller central stations have not been able to keep up with the growth of the business and the stockholders have either been unwilling or unable to put in more capital. The reputation of the plant as never having paid any dividends having tended to discredit it in local financial circles the company has been unable to raise the capital necessary for extensions to properly take care of its business. In some cases the stockholders or the company have been able to borrow a few thousand dollars from local banks which the company is carrying along in the shape of a floating debt. The fact that this floating debt is in existence year after year is not conducive to the good standing of the enterprise. The whole financial situation with the smaller central station company is thus radically different from that of many large corporations where a similar ratio of earnings to operating expenses would have maintained a company in good standing and would have made easy the floating of securities

enough to pay for improvements which would put the plant in first-class condition.

Now, without in the least wishing to encourage any stock watering operations, it is in order to inquire whether some of the legitimate methods used in the financing of the larger companies should not rightfully be employed to the advantage of all concerned by small central station companies. In other words, if a half dozen local capitalists owning a small central station company find that the plant is paying well above operating expenses but needs extensions and enlargement to keep up with the demand, why should it be necessary to pay for all extensions out of the earnings as has been done in so many cases? To be sure, these said half dozen stockholders may prefer to give up their dividends and enlarge the plant instead of increasing the capital stock and getting others into the company. If the earnings are sufficient to take care of all needed improvements and extensions, and if the stockholders do not need the dividends, well and good; but there is no reason whatever why the earnings of the plant should rightfully be made to take care of all extensions if by so doing as frequently happens the maintenance of the plant is not properly kept up because of the money going into extensions and the financial reputation of the company is suffering. We have known of case after case where a plant has struggled along year after year in this way, giving poor service to its customers and becoming generally discredited in the community, when by the addition of a little new capital combined with good business and engineering sense, it could be put in an excellent condition to give good service and to earn a much better percentage on the money invested. It is undoubtedly true that in some cases capital has been put into central station enterprises under the head of improvements and extensions, which really should be charged to maintenance, but, on the whole, in the financing of the smaller central station companies the tendency has been not to put in enough capital to keep the business on a good satisfactory basis to all concerned.

THINGS TO AVOID WITH LARGE INCANDESCENT LAMPS.

With the rapid increase in the number of incandescent lamps giving 40 mean spherical candle-power and over, a word of warning is called for on the necessity of keeping the bare unshaded filament of these units hidden from the eye as far as possible. The efficiency of these large units promises to be, and in fact now is, so much better than that of any smaller incandescent lamps obtainable that they are certain to be used in the future wherever the area to be lighted is not so small as to make a large unit wasteful. We are aware that some engineers have taken issue with our advocacy of high candle-power units on the ground that the quantity of light from them and the intrinsic brilliancy of their filaments make their use trying on the eyes and that they further defeat the purposes of good illumination by their blinding glare which makes it difficult to see objects anywhere in their vicinity. We believe, however, that the inherent higher efficiency of the larger units will insure their extensive use in the future and that the effect on the eye of the great brilliancy of the filaments and large quantity of light will have to be corrected by the proper shades, globes and reflectors, and by the proper placing of the lamps, rather than by cutting down the sizes of the units.

It is of first importance in using these large lamps to see that the purposes of good illumination are not defeated by exposing the lamp filaments so that a large amount of undiffused light can shine in the eyes. There are a few locations in which it is not best either to hood the lamp entirely with a reflector coming well down over it so as to hide the lamp filament, or to use a large diffusing globe over the lamp. When the present new high-efficiency carbon filament lamp was first brought out, it was accompanied with shallow types of reflectors which exposed a large portion of the lamp bulb. This would have been exceedingly objectionable but for the fact that the first lamps were about two-thirds frosted so that all of the direct light reaching the eye had to come through the frosting. No sooner had the two-thirds frosted lamp been brought out than both makers and users began to yield to the temptation to increase the lamp life by reducing the amount of frosting until to-day many lamps with only the tips frosted are to be seen in shallow reflectors. The effect is bad both from the standpoint of glare and general appearance. The frosted tip on a lamp placed in a reflector which exposes a large portion of the bulb gives the lamp a half-finished appearance, and the diffusing effect of the frosted tip is so small in comparison with the large amount of bare filament above it that the frosting might as well be left off. Where good illumination rather than glare is required, as in the great majority of cases in interior lighting, the deep bowl-shaped reflectors which have been brought out later for use over these large incandescent lamps are much to be preferred. Not only do they cover the lamp more completely, so that only a well diffused light reaches the eye of an observer from a distance, but if properly designed they can be made to throw a greater proportion of the light at ordinarily useful angles than any of the shallower reflectors. It is also possible to use these new high-efficiency units in large enclosing globes, spheres and hemispheres to replace clusters of small inefficient lamps commonly used now in such places. In fact, it may be said in general that groups and clusters of small inefficient lamps must in the future give way to a single lamp of equal candle-power and much higher efficiency.

As regards the proper placing of the new high candle-power lamps, it is evident that for ordinary purposes of general illumination in a room, lamps cannot be successfully shaded by a bowl or dome-shaped reflector unless placed pendant rather than pointing at an angle. It is further important that they be placed sufficiently high to get them out of the ordinary range of vision. How high they should be placed is usually a matter of compromise between efficiency, physiological effect on the eyes, and appearance. To secure the highest foot-candle illumination in the lower part of a room for a given expenditure of energy, lamps must be placed low, while on the other hand, to reduce the blinding effect of the lamps to a minimum, they must be placed high. The installation must, therefore, be a compromise. It is interesting to note here how well the tungsten lamp promises to fit in with the foregoing specifications as to the proper use of large incandescent lamps. The tungsten lamp as so far produced requires to be operated in a pendant or upright position. Since good illuminating engineering is now demanding that the majority of incandescent lamp sockets be placed either pendant or upright, it would seem that if the tungsten lamp be not later perfected so as to make it suited to sockets placed at an angle, there will be no great cause for regret.

An Issue of Lighting Stock Denied.

The New York State Commission of Gas and Electricity has denied the application of the Onondaga Lighting Company for a certificate of authority to transact business and to issue $1,000,000 capital stock, and of the Syracuse Lighting Company for consent to increase its capital stock from $4,000,000 to $9,000,000, and to lease its franchises, works, system and property to the Onondaga Lighting Company for a term of 999 years. The commission disapproves of the lease generally as to its policy, but more particularly objects to a provision permitting a semi-annual issue of common stock for betterments and for increasing the ratio of dividends upon all outstanding stock. The commission believes that the capitalization is excessive, because for the past two years it has paid a dividend of but 2 per cent. on the common stock and 5 per cent upon the preferred.

"To allow the proposed return on the present stock issues of $4,000,000, and the present bonded indebtedness of $5,000,000, as well as the same return on any future issued stock, would prevent any future regulation of the price of gas and electricity, sold by the Syracuse Lighting Company that did not recognize the outstanding securities as representing the value of the property and the rate of return fixed by the lease as a fair return thereon," says the commission.

"Allowing liberally for an increase in population, for a probable decrease in the cost of production and distribution, for increased consumption, as well as rate of consumption, and for other possible favorable factors, the commission is of the opinion that the contemplated returns upon these securities would impose an excessive burden upon the community, a per capita burden greater than is deemed reasonable or warranted.

"Not only is the proposed lease objectionable in these respects, but approval of it would in the future foreclose the State in the exercise of certain present and important powers of supervision over these interests."

Telephony in England.

Mr. John Ardron, assistant secretary of the British Post Office, in charge of telephones, foreign telegraphs, and wireless telegraphy, in a recent interview with the London *Mail* gave some interesting information regarding the telephone development of London and Great Britain. His statistics were for January 1, and a comparison of the figures with those recently given out by the telephone companies operating in New York furnishes a basis for comparison of the telephone service and development of the two greatest cities in the world, the one representative of Europe and Government control, the other of America and private enterprise.

Mr. Ardron said that in London, with an area of 640 square miles, at the present time there are 130,000 telephones, with a constant addition of new subscribers at the rate of about 10,000 a year. Ninety thousand of the total number of London telephones belong to the National Telephone Company, and 40,000 to the London Post Office. In Great Britain, outside of London, there are 260,000 telephones, 250,000 belonging to the National Telephone Company, and 30,000 to the Post Office.

In New York city, with an area of 326 square miles, there were in service and under contract 300,000 telephones, according to the reports of the companies published on January 1. Thus, it is seen that New York, in a territory only about half that of London, with a much smaller population, has two and three-tenths times as many telephones. If the number of telephones in the New York metropolitan area, which, roughly speaking, is all that territory within a radius of fifty miles of New York City Hall, be considered, it is found that this territory lacks but 30,000 telephones to number as many as there are in all Great Britain.

The number of new telephones added to the New York telephone system each year is 500 per cent greater than the yearly increase in London. Telephones in the various rooms of hotels and apartment houses, and in department stores, as they are to be found here, are practically unknown in London.

Mr. Ardron admitted that America is far ahead in telephone development. "Norway and Sweden," he said, "are ahead of us in proportion to the population, Germany is about equal, while France is behind. The United States, which has no Government service, is ahead of all."

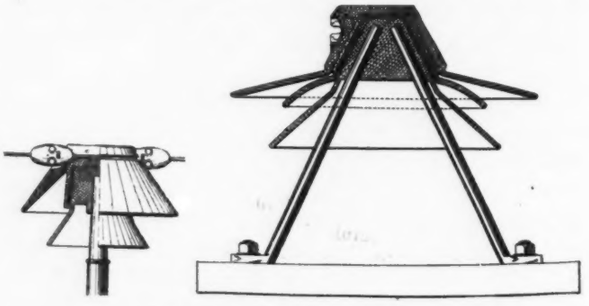
Novel Welfare Work of the Brooklyn Edison Company.

There has been recently instituted by Mr. W. W. Freeman, general manager and vice-president of the Edison Illuminating Company of Brooklyn, a far-reaching scheme of welfare work, which has hitherto been unattempted. This scheme consists in having instituted in the club rooms of the company an evening course in electrical engineering for the benefit of the male employees of all of the departments of the company. The course consists of high grade experimental lectures, such as are given in technical institutions, beginning with the elements, progressing to electrical measurements, direct and alternating currents. The sessions are held every Tuesday evening. Mr. Sydney W. Ashe has been retained as professor in charge, and he is assisted by Mr. A. S. Hegeman of the Brooklyn Polytechnic. Four lectures have been given so far, and the interest manifested has shown the great value of the work.

The course was made possible in a large measure by Mr. W. W. Freeman and Mr. W. T. Wells, general superintendent; and its success is due principally to Mr. W. T. Fairburn, chairman, and Mr. E. N. Kebbe, member of the Edison Club Committee.

Wire Insulator.

Under date of February 5, two patents were granted to Mr. W. G. Clark for improvements in insulators. The insulator shown in Fig. 1 is provided with sockets in the sides which are constructed so that the walls of the sockets engage clamps fastened to the wire, thereby holding the wire securely against the insulator by its own tension. The retaining clamps are constructed so that the wire is held rigidly or may have a certain



FIGS. 1 AND 2.—WIRE INSULATOR.

freedom of movement laterally. The wire may thus be stretched with facility without any tying means other than the clamps, and at the same time be held securely to the insulator. The insulator shown in Fig. 2 is particularly adapted for use in places where the wire is subjected to great strain. The object is to take the strain off the usual pin for the insulator, and transfer it to whatever the insulator is attached. By using an angle brace extending into the insulator opposite the point of strain, the latter becomes one of compression and not one of tension. A modification of the ordinary insulator is used, the insulator being elongated in the direction of the strain, so that it can support the load.

Electrical Journalism in 1874.

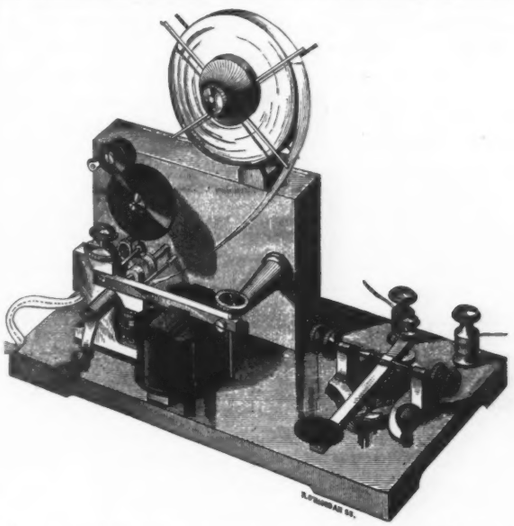
Founded as *The Operator* in 1874, with this issue the ELECTRICAL WORLD enters the second generation period of its first century. This incident may well afford occasion for a glance at electrical journalism in a period which bears a similar relation to the electrical movement of to-day that the period of Watt holds to the age of the steam turbine. The only electrical art was telegraphy, aside from electroplating, and this latter branch had only begun to add nickel plating to silver deposition.

The first issue of *The Operator* is dated March 1, 1874, and consists of a sheet of four pages, 9 in. by 12 in. in size. It is interesting to observe that at the beginning of the present year this journal returned to these original dimensions, having in 1883 changed to a page 11 in. by 14½, which was reduced to 9½ in. by 12½ in. in 1894. *The Operator* was issued semi-monthly until October 21, 1882, thereafter appearing as a weekly. With the issue dated January 6, 1883, the name was changed to *The Operator and Electrical World*, and three months later (April 28) this title was abridged to that of to-day. *The Operator* was then revived as a separate journal, appearing semi-monthly from May 1 to September 9, 1883, when it was discontinued and all effort concentrated on the weekly. On March 11, 1899, absorption of *The Electrical Engineer* brought a change of title to the *Electrical World and Engineer*, while the absorption of the *American Electrician* in January, 1906, had the reverse effect of shortening the title to that now borne. Through the *American Electrician* the journal also became the successor to *Electrical Industries* (monthly, December, 1889-April, 1896) and *Electrical Doings* (monthly, April, 1896-February, 1897).

When *The Operator* was founded it had to battle with two formidable rivals, *The Telegrapher* (October 16, 1865-February 3, 1877), then edited by J. N. Ashley and George Little, and the *Journal of The Telegraph* (1875-date), then as now the organ of the Western Union Telegraph Company, and which in 1877 absorbed *The Telegrapher*. In addition traces of ephemeral telegraphic journals are found in the columns of the early issues of *The Operator*, where there is mention of *Telegraphica's Ghost*, of which Mr. Walter P. Phillips was editor; *The Office Boy*, edited by J. D. Hasbagen and Wm. H. Eason, and *The Switch*, printed in Chicago. Other journals of short life belonging to the same period were *The Fraternity*, *The Plug* (Cincinnati), *Telegraphica* and *The Electric* (St. Louis).

The first proprietors and editors of *The Operator* were telegraphers in the employ of the Western Union Telegraph Company, and one of them, Mr. W. S. Williams, is yet an operator, at present with the Postal Telegraph Company. As the surplus income from the Western Union Company source doubtless sustained the journal in its infancy, there is only slight reference to, and no criticism of, the organ of that company, but *en revanche* there is every evidence of lively rivalry with *The Telegrapher*. The senior editor of this journal is paragraphed as a "280-pound man editing a four-pennyweight sheet," and is accused of being seen "coming out of Russell's printing office with the entire edition of his sheet wrapped up in a piece of brown paper." One cause of the exchange of compliments between the two journals was Mr. Thomas A. Edison, then 27 years of age and at the zenith of his career as a telegraphic inventor. Mr. Edison was a valued contributor to *The Operator*, and at the time was in disfavor with the rival journal, the junior editor of which, Mr. George Little, being the inventor of a telegraphic system which he was endeavoring to exploit to the disadvantage of some of the inventions of Mr. Edison. This led to a journalistic situation which at least added spice to the rather monotonous tenor of the pages of the two journals, which otherwise dealt in personal mention in the style of country journals, in verbose articles on telegraphic technics that often darkened rather than clarified understanding, and padded with scientific notes from foreign journals frequently in subject far above the telegraphic readers of the day.

It is announced in the issue of July 15, 1874, that Mr. Thomas A. Edison had for some time been engaged in perfecting a system of "quadruple telegraphy," for sending two sets of messages and receiving two sets at the same time over a single wire. It is stated that on July 8 President Orton and Messrs. Prescott, Hunter and Brown, of the Western Union Telegraph Company, met in Mr. Edison's works at Newark and witnessed the successful working of the quadruplex over circuits



EDISON'S INK RECORDER,
For Amateur Students and Private Lines.
[Patent applied for.]
SEND FOR CIRCULAR.
EDISON & MURRAY,
10 and 12 WARD STREET,
NEWARK, N. J.

FIG. 1.—EARLY ADVERTISEMENT FROM *The Operator*.

about 200 miles in length, two Philadelphia wires having been looped for the purpose. A test of sending for one hour was made with great success. A later note states that Edison had sold his quadruplex system to the Western Union Company for $400,000.

A letter in the same issue gives the New York personnel of the Automatic Telegraph Company, then operating a line between New York and Washington, and based upon an invention of Edison, who was electrician of the company, while Mr. E. H. Johnson, even then spoken of as "long and very favorably known in the profession," was superintendent.

The "Snapper" Sounder.

PRICE 30 CENTS.

$2.00 per doz
$1.50 1-2 do

Trade Mark. Patented May 12, 1874.

Polished nickel-plated base, 40c., *or* 6 *for* $2

Polished, with Knob and Screw Fastenings, 75c.

PRICE 75 CENTS.

Sent post-paid on receipt of price.

R. W. POPE, Box 5278. N. Y.

FIG. 2.—EARLY ADVERTISEMENT FROM *The Operator*.

The first advertisement for the journal was not secured until June and consisted of a full-page announcement of the L. G. Tillotson & Company, later The E. S. Greeley & Company.

The second advertisement was received from Edison and Murray, and is reproduced herewith, as is also that of Mr. Ralph W. Pope, an early advertiser, and now secretary of the American Institute of Electrical Engineers.

In the latter part of 1869 Mr. Edison came to New York from Boston, where he had established a reputation as a highly skilled operator, and where he first began to display his inventive genius. While looking for employment shortly after his arrival, he happened to drop in the office of the Law stock reporting telegraph, with which the late Franklin L. Pope was then connected, shortly after a breakdown which interrupted all business and gave rise to much consternation in the financial district. Mr. Edison located and remedied the trouble and was immediately employed by the company at a salary of $300 per month—almost triple what he had ever previously received. A very short time afterwards he produced the Gold and Stock printer, which at once superseded the Law apparatus and is the type of stock reporter which is in use at the present day. He then took up other telegraphic problems, and in the course of a few years obtained world-wide fame as an inventor, his greatest achievement being the quadruplex telegraph, which, as stated above, was perfected early in 1874. In 1873 he established a factory in Newark, N. J., for the manufacture of Gold and Stock printers, automatic telegraph apparatus, fire alarm instruments, learners' telegraph sets, etc. That the business routine of a manufacturing establishment conducted by Edison at that period—he was then 27 years old—would not be along regular orthodox lines might be taken for granted. Dickson in his "Life and Inventions of Thomas Alva Edison" gives the following account of his method: "I kept only pay roll accounts," said Mr. Edison, "no other kind; preserved the bills and generally gave notes in payment. The first intimation that a note was due was the protest, after which I had to hustle around and raise the money. This saved the humbuggery of bookkeeping, which I never understood, and the arrangement possessed, besides the advantage of being cheaper, as protest fees were only $1.50." That Mr. Edison had some reason for lack of faith in bookkeeping appears in another anecdote related in the same publication. When the Newark factory was first started a bookkeeper was employed, and at the end of the year reported a surplus of $7,500. On the strength of this showing Mr. Edison gave orders that the "boys" should have a "rousing jamboree" at his expense; but later, becoming suspicious at the unexpected prosperity, he spent a night going over the books personally and found, instead of a surplus, a deficit of $15,000.

At this period the Western Union had not entirely established its monopoly and *The Operator* contains frequent notes of competitors or prospective competitors. The most formidable of the former was the Pacific & Atlantic Telegraph, which during the year was absorbed by the Western Union Company. This was essentially a period of telegraphic invention, almost monthly announcements being made of new systems or radical improvements. Edison, of course, heads the list, other inventors being Elisha Gray, George Little, Patrick Delany, F. W. Jones, G. M. Phelps, Gerritt Smith, etc. Machine telegraphy had then a status which it is only now begining to recover. In the first issue of *The Operator* we read that the bulk of the Boston, Philadelphia and Washington business of the Western Union Company was done on printing machines. The Automatic Telegraph Company, of which Edison was electrician, used a perforated tape in sending and a chemical tape for receiving. During this year the Western Union Company completed its monopoly, and one result appears to have been the cessation of notable improvement in the telegraphic art for almost a generation.

Another subject of great interest to the readers of *The Operator* was the new building of the Western Union Company, at the corner of Dey Street and Broadway, into which the Western Union Company moved during the year from its old offices at the corner of Liberty Street and Broadway. In this day of tall buildings it is amusing to read the following description of the new Western Union Building. It will be recalled that after the fire in 1890 several stories were added to the building as originally constructed and described below:

"In height it is especially pre-eminent, being to-day the highest in America, the body of the building alone considered, and matched only in that regard by two or three of the high-shouldered cathedrals of the Old World. There is really something almost oppressive in the effect produced by its height, forcibly reminding the traveler of Strassburg Cathedral as seen at a distance of many miles, lifting its spire into the upper air and even its very body above the tops of the ordinary steeples. There will eventually, however, be nothing incongruous in the altitude of the Western Union Building owing to the fact that so many other buildings in the neighborhood are creeping up to a height that would not many years ago have been considered monstrous."

In the latter part of the year considerable space is devoted to the invention of the electromotograph by Edison. This rested upon the discovery that the friction between a stylus and a chemically prepared surface passing rapidly under it is reduced at the moment of the passage of current. Later Edison utilized the same property in a loud-speaking telephone. A note on the invention of "the telephone" by Prof. Elisha Gray is somewhat startling, but we find this to be a reference of a telegraphic system for transmitting music. A writer of the period, commenting upon this invention, which preceded the telephone proper by two years, predicted that "in time operators will transmit the sounds of their own voices over the wires." One issue contains an account of a primary battery swindle of the period, whereby it is stated certain gentlemen, whose names are given, "were played to the tune of about $180,000." The scheme was a "new form" of primary battery, for which it was claimed—and apparently demonstrated—that three cells would indicate 8 hp upon a dynamometer connected with a motor. It was later discovered that the motor was connected with a belt run by a steam engine in a room below.

In the issue of October 15 it was announced that the Western Union and Gold and Stock Telegraph Companies had decided to give the "new Gramme magneto-electric machine" a trial with a view to working all their lines by electricity generated by it. This means of supplying current to telegraph lines apparently did not receive favor at the time and was not taken up in earnest by telegraph companies until almost 20 years later, following the lead of the American Bell Telephone Company, which employed dynamotors on the telegraph circuits operated over its long distance telephone toll lines.

The issue of November 1 gives an extended account of the organization in Chicago of the American Electrical Society, the forerunner of the American Institute of Electrical Engineers. Mr. C. H. Haskins, now of Chicago, presided at the preliminary meeting; General Anson Stager was elected president; Mr. C. H. Haskins and Mr. George B. Prescott were among the vice-presidents, and among the directors were Mr. Franklin L. Pope, Stephen D. Field and Colonel R. C. Clowry, now president of the Western Union Telegraph Company. This society published three volumes of proceedings, called the *Journal of the American Electrical Society*. Volume I covered the years 1875-77; Volume II, 1878-79, and Volume III, dated 1880, consists of a single number.

The issue of *The Operator* dated December 1, 1874, contains a letter from Mr. Edison submitting a problem as follows: "Transmit alternately positive and negative currents within a closed circuit from a battery, all the poles of which are connected in the ordinary manner, using an ordinary Morse key to which no extra point or appliance whatever is to be applied. No device other than the battery, key and connecting wire to be used." Mr. Edison enclosed two diagrams, each solving the problem in a different way. Solutions to Mr. Edison's problem were offered by Mr. A. S. Brown, late chief engineer of the Western Union Telegraph Company; Mr. Thomas M. Brennan, now chief clerk of the Operating Department of the Western Union Company, and Mr. George D'Infreville, later chief electrician of the Western Union Company.

In glancing through the pages many familiar present-day names are encountered. In addition to some previously mentioned we find that of Mr. Patrick Delany, who has just invented a new system of telegraphy; Mr. F. W. Jones, then in Chicago, and who presented a paper in 1874 before the American Electrical Society; Mr. T. D. Lockwood, who had just come to New York from New England; Mr. W. J. Johnston, who the following year became proprietor and editor of *The Operator*, and soon after resigned as a Western Union telegrapher in order to be entirely free to conduct the publication as an independent journal; William Maver, Jr., Frank B. Rae, A. B. Chandler, E. H. Johnson, R. W. Pope, George A. Hamilton, T. R. Taltavall, Walter P. Phillips and others. All of these gentlemen were at that period prominent in their connection with telegraphy; in fact, aside from the few who secured important administrative positions with telegraph companies prior to the development of the telephone and electric light industries, about every name of prominence in telegraphic circles at this period later became identified with these industries. Possibly the backward state of the art of telegraphy during the quarter century following was largely due to this depletion of its personnel, which, moreover, could not be recruited to its former standard owing to the superior attractiveness of the new electrical field.

Cost of Electricity Obtained from Water, Steam, Gas and Oil.

At a meeting of the New York section of the American Electrochemical Society, held on February 26, Prof. Charles E. Lucke presented a paper discussing in detail the various factors which enter into the cost item of the energy consumed in electrochemical industries. The author discussed the electric generating station, in which the source of power is water, oil, steam or gas. In each case commercial sizes of machines were chosen. The oil engine driven station was assumed to contain six 160-kw units, four of which were to be in use constantly, the other two being held as reserve. In the gas engine driven station it was assumed that six 600-kw units were installed, two of which were held as reserve. The steam station was assumed to contain six 500-kw units, four being in use constantly. In the water power station the units installed were assumed to be operated continuously at full load. The initial cost of the installation was found to vary from $75 to $200 per kw for the water station, and from $110 to $150 per kw for the steam station, for either reciprocating engines or steam turbines; while the equipment in the oil engine driven station were estimated to cost $217 per kw, and that in the gas engine driven station $270 per kw. In each case it was further assumed that the total investment cost per year per kilowatt could be taken at 10 per cent. The operating cost was estimated from values found to exist in practice. On the basis of the above assumptions the author presented the following table showing the cost of electrical energy obtained from the various sources, the values being in dollars:

	Water		Oil.	Steam		Gas.
	Min.	Max.	Mean.	Min.	Max.	Mean.
Initial cost per kw.....	75.	200.	217.	110.	150.	270.
Investment cost per year per kw.....	7.5	20.	21.70	16.5	22.5	27.0
Operating cost per kw-yr.	1.	5.	56.9	52.5	52.5	38.5
Total cost of energy per kw-year	8.5	25.	78.6	69.	75.	65.5

In discussing Prof. Lucke's paper, Mr. H. G. Stott called attention to the fact that the actual proportion of operating charges to fixed charges will vary largely with the load factor of the station. Thus with a 50 per cent load factor, such as is common in railway service, the operating expense would be 61 per cent, the fixed expense 33 per cent, and other expenses 6 per cent, while with a 20 per cent load factor, such as is common in lighting equipments, the operating expense would be 30 per cent, the fixed expense 60 per cent, and the other expenses 10 per cent. It is seen, therefore, that in comparing various stations it is extremely important to consider the load factor. Moreover, it is not proper to assume that the cost of operating steam turbines is the same as that for reciprocating engines. As a matter of fact, while three men are required for each 5,000-kw engine unit, one man can care for two 5,000-kw turbine units. The maintenance charge of a turbine will be perhaps one-fifth of that for an equivalent reciprocating engine. The load characteristics of a steam turbine are quite different from those of a reciprocating engine. On account of the leakage past the blades the turbine has a lower efficiency at light load than has the engine, but it can carry enormous overloads with a very much higher efficiency than can the engine.

Mr. F. G. Clark, in discussing the variation of cost of energy with the load factor of the station, remarked that while with a load factor of 100 per cent the cost would be $35 per kw-year, at a 40 per cent load factor the cost would be $65 per kw-year, and at a 20 per cent load factor the cost would increase to $100 per kw-year. He drew attention to the fact that in comparing gas and oil engines with steam engines one should not neglect to consider that steam engines and steam turbines can carry enormous overloads, while gas engines and oil engines are limited to about 25 per cent overload. Therefore, it is not necessary to carry as much excess capacity in a steam equipment for peak loads as would be true with either a gas or an oil equipment. In the case of steam equipments it is possible to use water heat storage for equalizing the load on the boilers. Thus, immediately preceding the peak load it is possible to have the boilers filled with water at a high temperature and to shut down the feed pumps while the peak load continues, and depend on utilizing the energy stored in the heated water for the excess capacity demanded during the peak.

Recession of Niagara.

The recent agitation against the utilization of Niagara gives special interest to data on the rapid change and breaking down of the great cataract by the body of water hurled incessantly over its crumbling crest. Indeed it has been reasonably argued that the salvation of Niagara will be effected by giving it less to drink. Mr. G. K. Gilbert, of the U. S. Geological Survey, has just issued a pamphlet showing how rapidly Niagara is going backward upstream to Buffalo.

The data for computing the rate of recession of Niagara Falls include surveys of the crest line made in 1842, 1875, 1886, 1890 and 1895, and camera-lucida sketches made in 1827. During the period covered by these data the rate of recession has not differed to an important extent from the natural conditions. The present and prospective diversions of water for economic uses interfere with the course of nature and may be expected to modify the rate of recession.

The rate of recession of the Horseshoe Fall, or the rate of lengthening of the Niagara gorge, during the sixty-three years from 1842 to 1905 is found to be 5 ft. per annum, with an uncertainty of 1 foot. For the thirty-three years from 1842 to 1875 the rate was apparently slower than for the thirty years from 1875 to 1905. The rate of recession of the American Fall during the seventy-eight years from 1827 to 1905 was less than 3 in. per annum.

The time consumed in the recession of the falls from the escarpment at Lewiston to their present position, or the age of the river, is not here estimated. It can not properly be computed without taking account of all conditions, local and temporary, affecting the rate of recession, some of which have varied greatly from point to point and from time to time.

Mr. Gilbert's report is published as Bulletin No. 306 of the Geological Survey. It is accompanied by a report on the survey of the crest line of Niagara Falls by Mr. W. Carvel Hall, who made the survey in June, 1905. The work was done under a plan of co-operation between the Survey and Mr. Henry A. Van Alstyne, state engineer of New York. Mr. Hall adds two tables to his report, one showing the artificial monuments and other permanent reference points connected with the triangulation of the surveys, the other the distance between permanent reference points.

Underwriters' National Electric Association.

The annual meeting of the Electrical Committee of the Underwriters' National Electric Association will be held at the rooms of the New York Board of Fire Underwriters, 32 Nassau Street, New York City, on March 27 and 28 for the purpose of making changes and additions to the National Electric Code. As is well known, it has always been the endeavor of the Electrical Committee to make only such changes in the Code as are made necessary by progress in the art, or such as have been shown by some field experience to be necessary to safeguard against hazard, since changes in the code, even if necessary, cause more or less confusion and trouble. It will be remembered that at the last meeting of the Electrical Committee in December, 1905, there were submitted matters of such importance as to require further consideration before action was taken. These various matters were referred to sub-committees, by whom they were considered during the past year, and their reports will be considered by the full committee and finally brought before the general meeting in New York for action. The following committee reports will be considered: Committee on Rules for Signaling System; Committee on Slow-Burning, Weather-proof Wire; Committee on Wiring and Equipment of Street Railway Property, including rolling stock; Committee on Double and Single-pole Switches; Committee on Variable-speed Motors; Committee on Theatre Wiring; Committee on Construction and Installation of Rheostats; Committee on Series Lamps; Committee on Insulating Joints; Committee on Outlet Boxes; Committee on Metal Mouldings; Committee on Laboratory Report in Condulets; Committee on Rule 13 A; Committee on Omitting Fuses in Neutral of Three-wire Systems, and Committee on Electric Signs. There are also a number of suggested changes in the rules to be given consideration, as well as a number of miscellaneous suggestions.

The Committee on Double and Single-pole Switches is of the opinion that there is no reason why a single-pole switch should not be permitted when installed where under the rules no switch would be required. The other recommendations of this committee are that single-pole switches must never be placed in the neutral wire of a three-wire system except in the two-wire branch or tap circuit, described in Rule 21 D. Three-way switches are considered as single-pole switches and must be wired so that only one pole of the circuit is carried to either switch.

The Committee on Variable-speed Motors reported the following rule: All variable or varying-speed, alternating-current motors must be marked with the maximum current which they can safely carry for 5 minutes and 30 minutes, respectively, starting cold. To this rule are a number of explanatory notes.

The Committee on Theatre Wiring has suggested a complete set of special rules and requirements for the installation of wires and apparatus for electric light, heat and power in theatres where the potential of the system does not exceed 250 volts.

An amendment to one of the rules which has been suggested by the Committee on Construction and Installation of Rheostats is that variable-speed motors, unless of special and appropriate design, if controlled by means of field regulation, shall be so arranged and connected that they cannot be started under weakened field.

The sub-committee on Series Lamps has recommended that Section *b* of Rule 31 be stricken from the Code.

The Committee on Outlet Boxes has amended Rule 24, Section *u*, and has recommended that Section *e*, Rule 22, be stricken from the Code.

The Committee on Metal Mouldings is not prepared to recommend the prohibition of the use of wooden mouldings for all classes of service, but offers certain changes and additions to specifications in this connection now in effect.

In regard to the frequency of ground connections required by Rule 13 A, Section *b*, paragraph 3, the committee appointed to consider this feels that in order to properly accomplish the object of this rule grounds should be made as frequently as required in this rule and that if trouble from stray current results it can be remedied in other more satisfactory ways than by decreasing the frequency of ground connections.

The Committee on Electric Signs has recommended the adoption of 11 requirements and specifications for the construction and equipment of electric signs.

One of the changes in rules suggested is to add a new section to Rule 24 to the effect that in frame buildings, where the work is not exposed to moisture and the system has a difference of potential not exceeding 300 volts, approved flexible tubing may be used as a complete tubing system under certain enumerated restrictions.

Under the miscellaneous heading it is suggested that under Rule 22, Section *a*, all service switches should be required to be of at least 25-amp. rating. It is also suggested that a fine-print note be added under Rule 54, Section *b*, advising that the bottom of cabinets be given a decided slant to prevent the accumulation of dust, etc., and to prevent its being used as a shelf. It is also suggested that sockets and receptacles be rated in volts and amperes rather than in candle-power. Other suggestions call for general rules governing the construction and connection of outdoor signs; the installation of mercury vapor lamps; the provision of a thoroughly safe stand to be supplied as a part of the equipment of every electric smoothing iron put on the market, and that some action be taken regarding the exposed, live incandescent lamp bases found on some of the new types of lamps.

The following opinion of the laboratories has received the endorsement of the Electrical Committee. In sockets and receptacles of standard forms a ring of any material inserted between an outer metal shell of the device and the inner screw shell for insulating purposes and separable from the device as a whole, is considered an undesirable form of construction This conclusion was reached as a result of experience showing such rings to be easily broken or frequently left off altogether, thus leaving no reliable means of preventing the outer and inner shells from coming in contact with each other. This does not apply to the use of rings in lamp clusters or in devices where the outer shell is of porcelain, where such rings serve to hold the several porcelain parts together and are thus a necessary part of the whole structure of the device.

Telephony in Railway Service.

Before the New England Street Railway Club on January 31, at Boston, Mr. C. J. H. Woodbury read a paper on the application of the telephone to railway service. His address included considerable data as to electric railway dispatching, as based on the telephone. In regard to some other points, he said:

The term "labor saving" invention is generally a misnomer, for production increasing devices, but the telephone is in the former class, as Mr. Frank Thomson, President of the Pennsylvania Railroad, said that the telephone was the only invention introduced during his business career which had been a time saving device, for while all of the others had added to his work, the telephone had enabled him to transact his duties with so much greater rapidity that it gave him more time to devote to matters of the policy of that great corporation.

The manifold applications of the telephone is indicated by some of the railroads which also have connection with the mining of coal and their private branch exchanges not only connect with the offices at the headquarters of various divisions of the railroad, the operation of trains, but also extend down into the coal mines and out to the docks where the coal is shipped, and even connected to telephones in the cabins of the vessels transporting coal, or the tugs which tow the coal barges. On the Mexican Central Railroad all of the cabooses are equipped with telephones so that all freight trains may be at any time

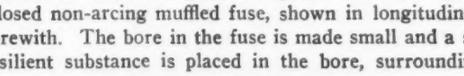
in communication with the superintendent's office, in the same manner that the wrecking cars of steam railroads are equipped with telephones which can be attached temporarily to wires of telephone lines near the road by means of rods carrying wires ending in hooks and in that manner becoming in communication with the supervising officers.

One of the many instances of the service of the telephone in cases of grave emergency occurred on May 11, 1905, when a passenger train near Harrisburg struck a car loaded with dynamite, whose explosion killed 21 and wounded 150, who were taken to the Harrisburg Hospital. The Pennsylvania Telephone Company set up a private branch exchange in that hospital which was operated by Mr. L. H. Kinnard, General Manager, while Mr. J. A. Crosman, jr., Secretary and Auditor of the Telephone Company, established a card index system on which the names of the wounded and dead were placed as far as known, with the nature of the injuries and the probable outcome of the case as judged by the surgeons in charge. This card index also contained the exact location of the patients in the hospital wards and was continued with additional information from the examining surgeons and ward physicians.

Some of the leading express trains are equipped with telephones which are attached to the central office system at terminals, and also at intermediate points where the stay is longer than for the change of passengers and baggage.

Non-Arcing Muffled Fuse.

Mr. Frank B. Cook was granted a patent on February 12, for an enclosed non-arcing muffled fuse, shown in longitudinal section herewith. The bore in the fuse is made small and a sponge and resilient substance is placed in the bore, surrounding the



NON-ARCING MUFFLED FUSE.

fusible conductor. The gases produced when the fuse blows are absorbed by the spongy substance which also expands and stops the arc, so that there is neither noise or flash attending the disruption of the fuse.

CURRENT NEWS AND NOTES.

A TOKIO SUBWAY.—It is stated that Tokio is to have a subway 12 miles long, costing only $25,000 a mile to construct. The estimate seems low, but labor is cheap in Japan, and the captors of Port Arthur know how to burrow.

POSTAL TELEGRAPH WAGES.—The officers of the Postal Telegraph-Cable Company have ordered an increase of ten per cent in the salaries of all operators, traffic chiefs, wire chiefs, assistant chief operators and managers, in all of the offices of the corporation in the United States.

IOWA ELECTRICAL ASSOCIATION will hold its next convention at Clinton, Ia., April 18 and 19. Prof. L. B. Spinney, Iowa State College, Ames, Ia., is secretary of the association. The Iowa Street and Interurban Railway Association will hold its convention on the 19th and 20th, at the same place.

SOCIETIES IN CINCINNATI.—Members of the Electrical Engineers' Club, the Civil Engineers' Club, Mechanical Engineering Club and the Cincinnati Chapter of the American Institute of Architects met a few days ago and adopted a constitution and by-laws for a new organization which will include them all. They believe that it will be well to form a closer alliance among the engineers. The plant is to have club rooms and a library.

NEW ZEALAND POWER.—Some great electrical engineering projects have been submitted to the New Zealand government by its engineer in chief, in the course of a report on the utilization of New Zealand's abundant water power. One of the most notable schemes aims at utilizing the famous Huka Falls, and supplying the Auckland district with 76,000 horsepower, the estimated cost of the necessary plant and works being $8,000,000.

SINGLE-PHASE TRACTION.—At a meeting of the Electrical Engineering Society of Columbia University, to be held on Wednesday, March 6, Mr. W. S. Murray, electrical engineer for the New York, New Haven & Hartford Railroad, will discuss the subject of single-phase traction. The lecture will be held at 8 p.m. in room 301, Engineering Building, Columbia University.

CONNECTICUT COMMISSION.—Mr. Rogers, of Danbury, has introduced a bill in the Connecticut Legislature to establish a Commission of Gas and Electricity to comprise three members, nominated by the Governor and confirmed by the Senate. It is to have general supervision over all persons or corporations supplying gas or electric currents for light, heat or power purposes, as to prices, quality and the like. The main office of the commission is to be in Hartford, and a branch in New Haven.

RAILWAY SIGNAL ASSOCIATION.—A stated meeting of the Association will be held at the Great Northern Hotel, Chicago, Mar. 18. The subjects for consideration are as follows: 10 a. m. to 12 noon, discussion on general specifications for electric interlocking; 12 noon to 1 p. m., discussion on installation and maintenance of storage batteries; 2.30 p. m. to 3.30 p. m., discussion on signal lamps, design of, etc.; 3.30 p.m. to 4.30 p. m., discussion of special committee report on interlocking and block signals.

FIRE ENGINES.—The German *Export Review* states that Berlin intends to make trials with automobile fire engines, for which purpose the sum of $12,000 has been appropriated. One electric car and one steam car are to be put in service, and to be run daily until each will have made 10,000 kilometers (621 miles). In case the trials prove satisfactory a complete set of new fire engines is to be proposed. Berlin now spends $62,000 a year on horses for fire engines, which sum would be available for motors.

CHICAGO POLITICS.—Mayor Edward F. Dunne has been renominated for mayor by the Democratic City Convention, which by resolution pledged the party in Chicago to the principles of the referendum, to municipal ownership of all public utilities, against franchises for utility corporations and to oppose at the polls the traction ordinances passed by the City Council, which will be voted on at the next election. After his nomination Mayor Dunne spoke of the record made by his administration and attacked the traction ordinances. The resolutions were adopted without a word of opposition.

ALPINE ICE.—It is stated that the introduction of electric railways into Alpine districts has been the means of establishing a new and somewhat strange industry—namely, the quarrying of glacier ice for distribution in large cities. It would appear that certain of the Swiss communes have been able to grant concessions of their glaciers for this purpose, and blocks of ice, often of large size, blasted out of the glacier are transported to the vicinity of the stations for conveyance, in carefully refrigerated vans, to Lyon and other large cities remote from the Alps. Glacier ice, which is perfectly pure and transparent, and which has many qualities which are greatly appreciated by consumers, commands a higher value than that of the usual kind obtained from frozen ponds or lakes.

SUBMARINE CABLE TELEGRAPHY.—Light is often lost of the fact that submarine cable telegraphy as an art was developed independently of the transatlantic cables of 1858 and 1866, which merely figure in the art as longer lines than numerous predecessors. The first submarine cable was laid between Dover and Calais in 1850, and prior to the unsuccessful Atlantic cable of 1858, more than 50 lines had been laid, of which 16 were over 100 miles in length, and two were 500 miles long. Between 1858 and 1866, the date of the second and successful Atlantic cables, more than 60 cables were laid throughout the world, a number having lengths ranging from 400 to 700 miles.

GRAHAM BELL MEMORIAL.—The Bell Telephone Memorial Association has asked a grant of $10,000 from the government of Ontario. The association was formed for the purpose of purchasing as a public property the Bell homestead on Tutela Heights, and erecting a monument on a central site in the city of Brantford to the memory of the inventor of the telephone, who however, happens still to be alive, although the fact hardly seems to be realized in the Dominion. It is estimated that not less than $40,000 will be required. Toward this $9,300 has been subscribed by private individuals, $6,300 by citizens of Brantford. It is anticipated that the people of that city will contribute $15,000 in all, and the province is asked to give $10,000. It is understood that the province will contribute something toward the fund. The amount is not announced as yet.

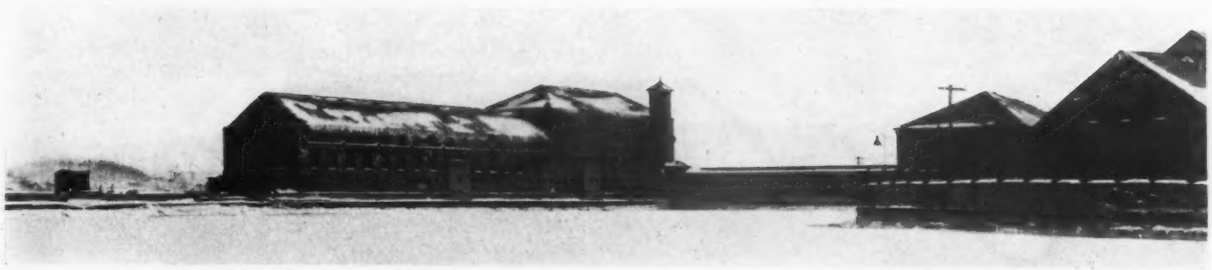
DEATH OF PROF. MOISSAN.—Announcement was received from Paris of the death there, February 20, after an operation for appendicitis, of Prof. Henri Moissan, well known as a chemist, and through his researches with the electric furnace. Deceased was born in Paris in 1852, and was consequently about 55 years of age. In 1887 he won the Lacaze prize for his experiments with fluorine, which he was the first to isolate and liquefy. His most striking success in the use of the electric furnace was the artificial production of minute diamonds by the sudden cooling of molten iron or silver impregnated with carbon. His lecture in New York, in October, 1896, on his researches with the electric furnace, will be recalled by many. Upon that occasion a banquet was given in his honor by leading American scientists, chemists and engineers. Prof. Moissan was the author of a work on the Electric Furnace. Last December he was awarded the Nobel prize for his experiments in the isolation of fluorine.

PUBLIC UTILITY RATES.—The bill introduced in the Indiana Legislature by Representative Daily to prevent a public utility company from increasing its rates after once having decreased them "in order to destroy competition—or to prevent cut-throat competition," as its author claims, has caused a great stir among the electric, the heating, the water, the telephone and other corporations, and many representatives have visited the Legislature to protest against the bill being enacted into law. Officers of the companies that have harnessed the St. Joseph River, and are selling electricity in South Bend, Elkhart and other cities, state that during several months in the year they have more power than they can sell at the usual rate. To dispose of their product during these months they have reduced the price on the surplus and sold it to different factories and others in need of power. They assert that several million dollars had been invested in dams and electric plants along the St. Joseph, and that similar projects would, if the bill became a law, be abandoned, as capital could not be induced to make such an investment.

MATTERHORN RAILWAY.—Advices from Geneva, Switzerland, state that two engineers, successful in their work in designing mountain railroads, have applied to the Federal Council for a franchise for the construction of a railway from Zermatt to the top of the Matterhorn. The scheme consists of two sections—the first a cog-and-rachet track from the Viege-Zermatt station to the Lac Noir (2,508 meters), tunneling through the Hoernli Peak; the second two funiculaires from the refuge station to the summit (3,052 meters). The whole system is to be worked electrically and the promoters propose to construct buildings at the summit sufficient to accommodate a certain number of visitors, including, if feasible, a compressed air room for persons who suffer from mountain sickness. It is estimated that it will require four years to construct the railroad and that it will cost 10,000,000 francs. The journey from Zermatt to the summit will require one hour and fifty minutes and cost 50 francs. At present the ascent takes twenty-four hours and the charges for guides amount to 180 francs. Alpinists are bitterly opposing the scheme, on the ground that it would make one of the finest and most difficult peaks in Switzerland accessible to every cheap tourist. No evidence has been adduced to show why the "cheap tourist" should not have the mountains made accessible to him.

RAILROAD BLOCK SIGNALS.—The Inter-State Commerce Commission has made an exhaustive report concerning the investigations made of the workings of the block system to prevent railroad accidents. The commission recommends the passage of a bill which it submitted a year ago that would compel all railroads to adopt the system, but now suggests that the time for compliance with the compulsory features be extended three or four years from the present. The report estimates that it would take from one to three years for all roads to equip with the block system, the difference in time depending upon the time required to train the operators and for manufacturers to supply the apparatus needed. Whether a law is passed at the present session or not, the commission asks that it be authorized to make an official investigation of all train accidents. Reference is made to the commission's investigations of the recent wrecks on the Southern and the Baltimore & Ohio railroads, both of which have the block system. Although these investigations are not complete, the commission says that the wrecks cannot be charged to the failure of the block system, but rather to the laxity of the operation of the system. There are now 48,743 miles of railroads operating trains under the block system, of which 6,827 miles are automatically operated and 41,916 controlled by manual apparatus.

LONDON'S LAMENT.—A special cable despatch from London of February 23 says: "The greatest popular demonstration seen in London in many years occurred this afternoon, when uncounted thousands marched through the principal streets to Trafalgar Square, where a mass meeting was held in opposition to the socialistic policy of the London County Council. The municipal reformers were themselves astonished at the evidence given of the popular revolt against the extravagance and incompetence shown in municipal ownership experiments which have so damaged London's credit. The procession was more than a mile long and included many unique features. Fifty men carried hods of rotten bricks from the Council's famous brick making yards at Norbury. Others carried some of the Council's surplus Austrian blankets from a lot of 2,000 unloaded upon the municipality because a requisition for 200 had a cipher added to it. There were fifty powerful gramophones in line which ground out fervid comments upon "wastrels" for the delectation of the great crowds along the route. Cartoons and election mottoes without number were carried upon drays and floats. A huge representation of a County Council steamboat was inscribed: "One man, one boat." The enthusiasm was greatest in Trafalgar Square, which was literally packed, many thousands being unable to get within earshot of Nelson's monument, which was used as a rostrum. There were speeches by half a dozen members of the House of Commons and leaders of the Municipal Reform party and the meeting adopted a resolution setting forth that "this mass meeting of London ratepayers indignantly protests against the increasing burden of rates caused by the Progressive Socialist party and pledges itself to exert every effort to turn the wastrels out on March 2 and place in power the party of municipal reform."



POWER STATION OF THE YORK HAVEN WATER AND POWER COMPANY AT YORK HAVEN, PA.

Electric Transmission System of the York Haven Water and Power Company.

THE hydro-electric power station of the York Haven Water & Power Company, on the Susquehanna River at York Haven, Pa., is one of the largest in the State, and was built for the purpose of supplying electricity throughout the counties of York, Dauphin, Cumberland and Lancaster. Much property surrounds the power station site, which is owned by the power company, the original intention having been to lease the ground to large manufacturing concerns who would buy electricity in bulk, the power company supplying it at a very low cost, much after the system which now obtains at Niagara Falls, N. Y.

To insure a durable foundation for the power house and its massive machinery, blasting and excavating below the surface had to be resorted to and a firm mass of rock far below the river bed was reached. Upon this the power house is constructed. The walls are of masonry and vary in thickness from 10 ft. at the bottom to 3 ft. at the floor line. From this point up the structure is of brick and the walls are 2 ft. thick. Windows on all sides provide ample light and ventilation.

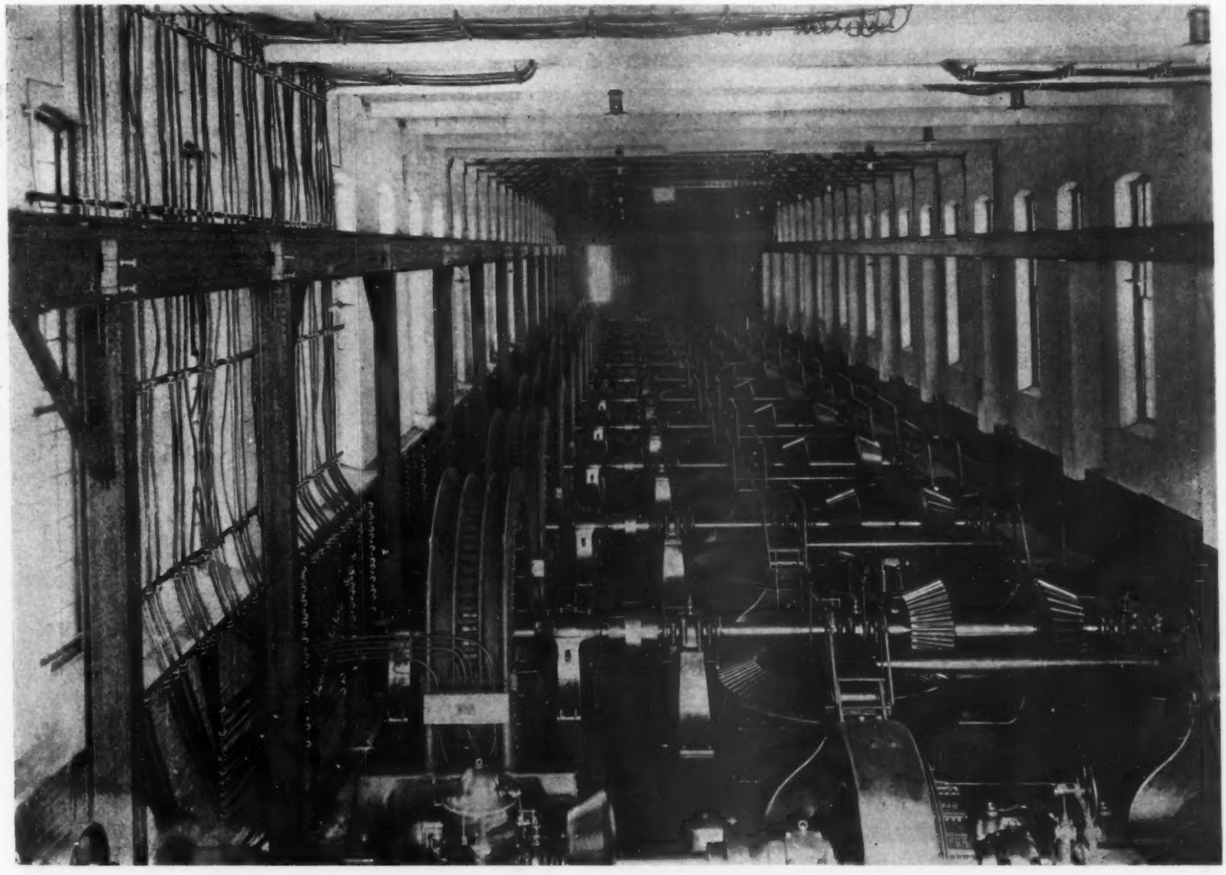


FIG. 1.—INTERIOR VIEW OF THE HYDRO-ELECTRIC STATION OF THE YORK HAVEN WATER AND POWER COMPANY.

The power house when complete will be 478 ft. long and 51 ft. wide. Extending from the building to the falls is an immense granite wall over 3,500 ft. long and from 28 to 34 ft. high. This wall is 6 ft. thick at the top and from 16 to 20 ft. thick at the bottom. It encloses a race 500 ft. in width and having an

Just above the power house there is a small spillway with log booms extending diagonally across the race for deflecting the ice, etc., to the overflow. The wheel pits are 19 ft. deep and extend the entire width of the power house, opening to the forebay. They are protected by iron racks and are made acces-

sible by lowering large head-gates of structural iron weighing about 11 tons. Each pit contains two 78.5-in. inward flow turbines hung from a spring bearing in the top of the draft tube. The turbines are level with the floor of the pit and are about

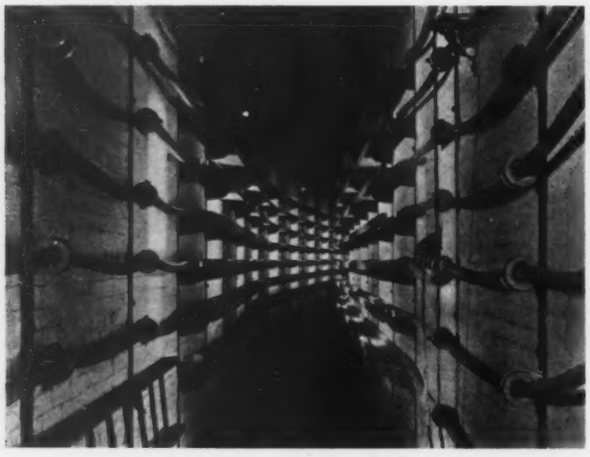


FIG. 2.—CABLE ALLEY JOINING POWER HOUSE AND TRANSFORMER HOUSE.

6 ft. above the low-water mark. The draft tubes are 10 ft. long and extend well under water, the effective head under normal conditions being about 21 ft. Float gauges on the switchboard gallery show at a glance the height of head and tail water. The turbines were built by the Poole Engineering Company, of Baltimore, Md., and are rated at 550 hp each, or 1,100 hp per pair.

The turbines are of special design, the buckets being made of pressed steel and having cast gun-metal hubs and guide rims. The shafts extend from the turbines vertically to the miter gears above the main floor and each is encased in a cast-iron tube which protects it from the action of the water and insures longevity both to the shafts and bearings, which sustain them in line. The spring bearing is located just above the runner, the shaft being held in line by a truss bearing at the top. Each shaft has a large gear wheel fitted with wooden cogs, which mesh with a beveled pinion on the generator shaft. The gates of both turbines are operated by one rack with suitable gearing and hand wheel.

At present there are installed ten pairs of turbines for the ten generators, five of which are equipped with governors, one Sturgess and four Lombard governors being used. Two of the Lombard governors are equipped with individual pumps belted to the generator shaft. An accumulator system is also in use consisting of a large oil pump, which maintains a pressure of 200 lb. per square inch. A 6-in. pipe runs the length of the building and is tapped for the different governors. A return pipe of the same size is provided with a small pump belted to a small direct-current motor, the latter outfit maintaining a vacuum of about 25 in. The large pump for the accumulator is geared to a three-phase S. K. C. multi-speed induction motor with a wound motor and a controller for cutting in iron grid resistance. This motor is supplied with current at a potential at 220 volts from two transformers connected to the main alternating-current bus-bars. Current for 22 enclosed arc lamps used for general station lighting is also taken from these transformers, while clustered incandescent lamps hung below the crane girders on each side of the room are supplied with direct current from the exciter bus-bars.

FIG. 4.—TRANSFORMER HOUSE AT YORK HAVEN.

The turbine bearings are supplied with oil from a gravity system. A tank on the switchboard gallery supplies each turbine, the line terminating in a ⅛-in. brass pipe fitted with a regulating valve at each cup. The feed is regulated to suit the consumption and after passing through the bearing the oil is caught and returned to a filter, whence it is pumped back to the supply tank in the gallery.

The generators are S. K. C. three-phase inductor alternators rated at 875 kilovolt-amp. and generating 60-cycle current at a potential of 2,400 volts, the normal speed of the generators being 200 r.p.m. The generators are rugged in construction and may be short-circuited without injury. They are easily synchronized and when thrown together anywhere near the

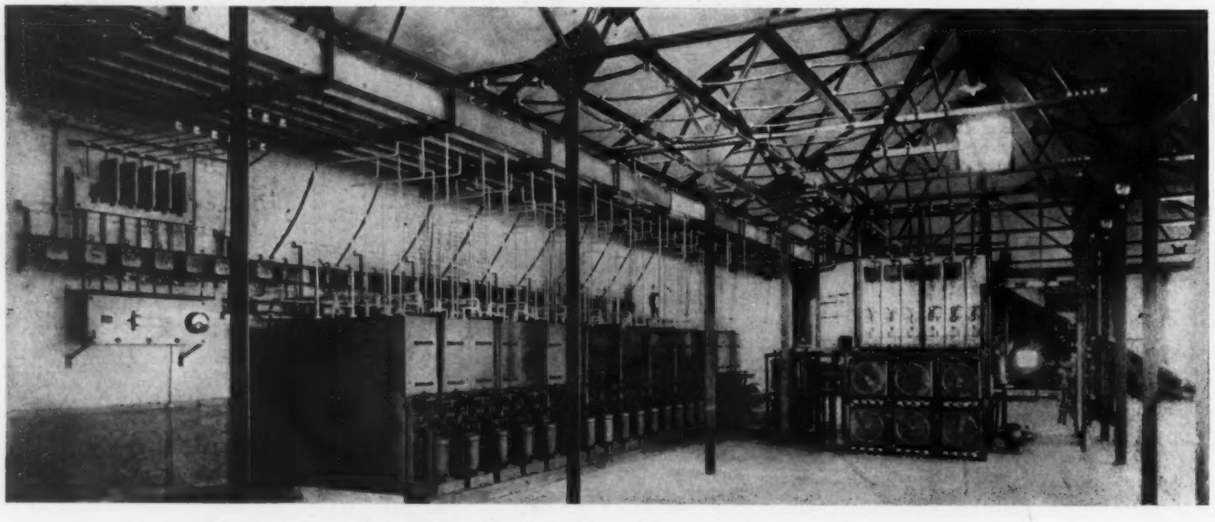


FIG. 3.—VIEW OF THE SWITCHBOARD GALLERY, YORK HAVEN WATER AND POWER COMPANY'S STATION.

synchronizing point will pull into step with very little fluctuation. They do not get out of step very easily, staying together during severe lightning disturbances or loss of load by short-circuits. The generators and system throughout are delta-connected; 200,000-cir.-mil rubber-covered cable leads run from the generators to the switchboard gallery, passing through the floor in porcelain tubes to the rear of the switches where two potential transformers and two current transformers for the switchboard instruments are located. Short lengths of ⅝-in. copper rod insulated with cambric and asbestos lead to the switches. Each generator has two three-pole, single-throw, 500-amp. oil switches so as to enable it to be connected to either set of bus-bars, the entire equipment from the generators to the sub-station feeders being in duplicate. Two 250-kw, 125-volt, S. K. C., compound-wound exciters furnish the direct current for the generator fields, each machine being connected through bevel gears to a small turbine and regulated by hand. Each exciter has sufficient capacity to excite the entire equipment of alternators, besides supplying current for small motor equipments in use around the station.

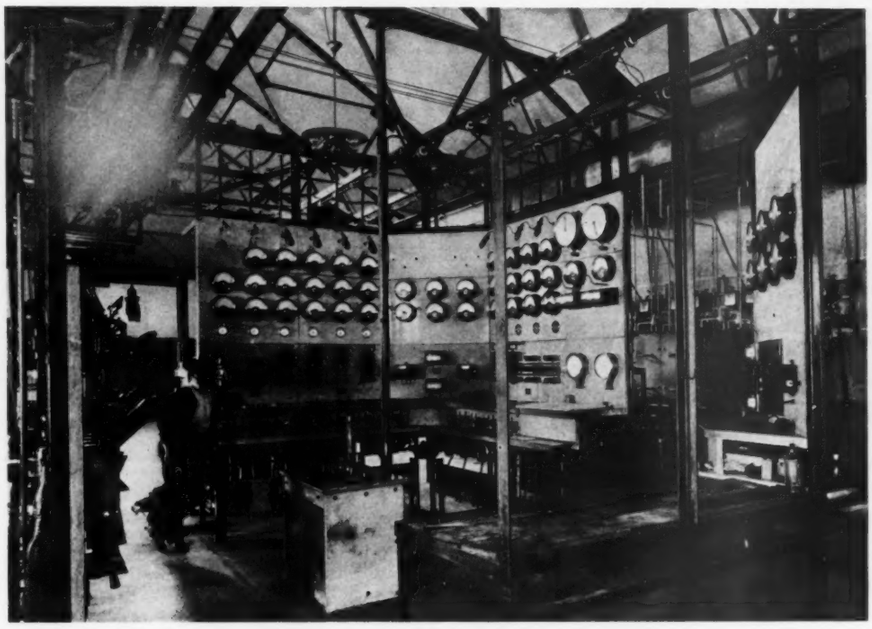


FIG. 5.—MAIN SWITCHBOARD IN POWER HOUSE.

At the southern end of the switchboard gallery and directly under the generator bus-bars are three marble panels, which take current from the busses overhead and feed it into the lines running to the transformers and distribution panels in the paper mills of the York Haven Paper Company, the Chase Felt & Paper Company, of Cly, Pa.; the Susquehanna Roofing Company, of Cly, Pa.; the American Phosphorous Company, at Falls, Pa., and the Pennsylvania Railroad Company. The York Haven Paper Company also runs several wheels from the race of the power company.

The main switchboard, a view of which is given in Fig. 5, is very compact and is made up of nine panels at present. Two panels control three generators each and one panel controls four generators. The equipment of instrument switches, etc., for each generator panel is alike in every particular, and the switching equipment for one generator occupies a strip on the switchboard 12 in. wide. At the top of each of these strips is an incandescent lamp which is illuminated as the generator comes up to speed and lights up the instruments. The instrument equipment for each generator consists of a 1,000-kw polyphase indicating kilowattmeter connected through a Y-box, a 250-amp. generator ammeter and a 150-amp. field ammeter. At the bottom of the strip is a General Electric two-pole, closed-circuit time limit relay having its two coils in series with the ammeter and wattmeter so that a short-circuit or overload on any phase will operate both solenoids and indicate on the ammeter and wattmeter. Each generator is provided with a transparent numbered bull's-eye in the switchboard, which is lighted by a 52-volt lamp back of it. This lamp is in series with a similar lamp in a signal box hung over the center of the generator room, and which serves as a signal to the machine man.

This box contains compartments numbered to correspond with the machines; also a "start," "stop," "raise" and "lower" signal and an "A" and "B" signal to correspond with the letters on the exciters. These signals are operated by small double-pole, double-throw switches on the operating table in the center of the switchboard gallery.

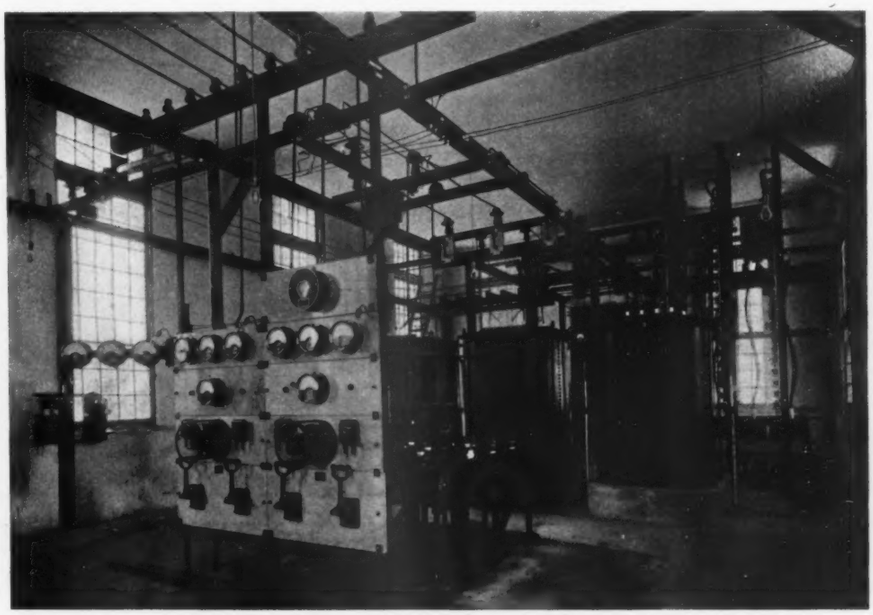


FIG. 6.—GENERAL VIEW OF SUB-STATION AT STEELTON, PA.

Each generator has two sets of synchronizing receptacles and voltage receptacles. The main generator switches are closed by

a large solenoid taking about 50 amp., and are held shut by a small magnet whose armature is attached to a toggle joint. A small switch on the main board, with copper leaf contacts, operates the main switch and is held shut against a light spring by two magnets, the main switch being opened by a heavy spring. The generator switches are enclosed in slate compartments and are of very heavy construction.

The synchronizing panel contains for each bus a Lincoln synchronizer, a lamp and voltmeter for the incoming machine, a Thomson horizontal, edgewise, open-scale voltmeter for regulating the bus voltage and a Bristol recording voltmeter. Each machine's field coils have in circuit with them an iron grid rheostat. Shafts having a hand wheel in line with the generator instruments connect to the blade contacts by chain and sprocket; the rheostats being arranged directly behind the switchboard in two tiers, as shown in Fig. 3. The shaft for each rheostat has a gear which may be thrown in mesh with a worm on a transverse shaft by pushing the hand wheel down. This transverse shaft is connected to a 1-hp slow-speed series-wound motor, which is thrown into circuit by a small two-pole, double-throw switch on the small operating table. The field adjustment is made by hand and then the shaft is depressed, all the fields being then regulated by the motor simultaneously. The operating table contains a push button switch for ringing a large bell to call the attention of the machine man to the signals, and is also supplied with a speaking tube for communication with the head machine man.

There are two totalizing panels each having three 5,000-amp. ammeters; two Stanley single-phase watt-hour meters, a power factor indicator, and a frequency indicator. Vacant spaces on the switchboard provide for three more panels for controlling ten additional generators similar to the ones now in use. One exciter panel has switches for the two exciters, each of which is provided with a Weston voltmeter, a hot-wire, 2,500-amp. ammeter and an I. T. E. circuit-breaker in the negative lead, a rheostat in the shunt field and a shunt field switch. The main exciter switches are single-pole, single-throw and the exciters may be paralleled by means of a double-pole, single-throw switch, which ties the busses together. The exciters may be run in series if desired, and this feature provides a simple means of rapidly charging a shunt field in case one machine should build up reverse, without opening any connections. The cables from the exciters are 2,500,000 cir. mils in cross-section. The switchboard is completed by a lighting panel controlling eight circuits for incandescent lamps throughout the station and transformer house and a small panel for controlling direct current for various motors throughout the building.

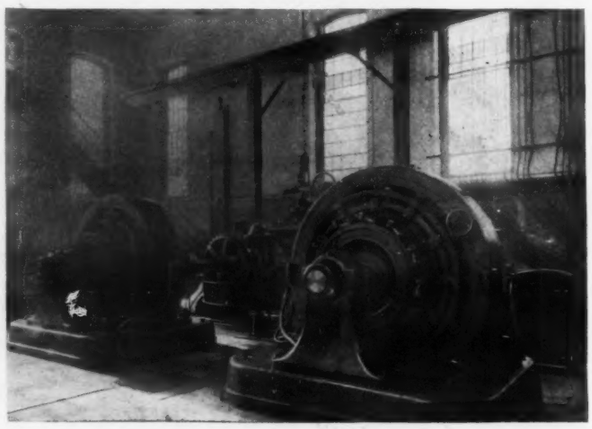


FIG. 8.—EXCITER UNITS IN POWER HOUSE.

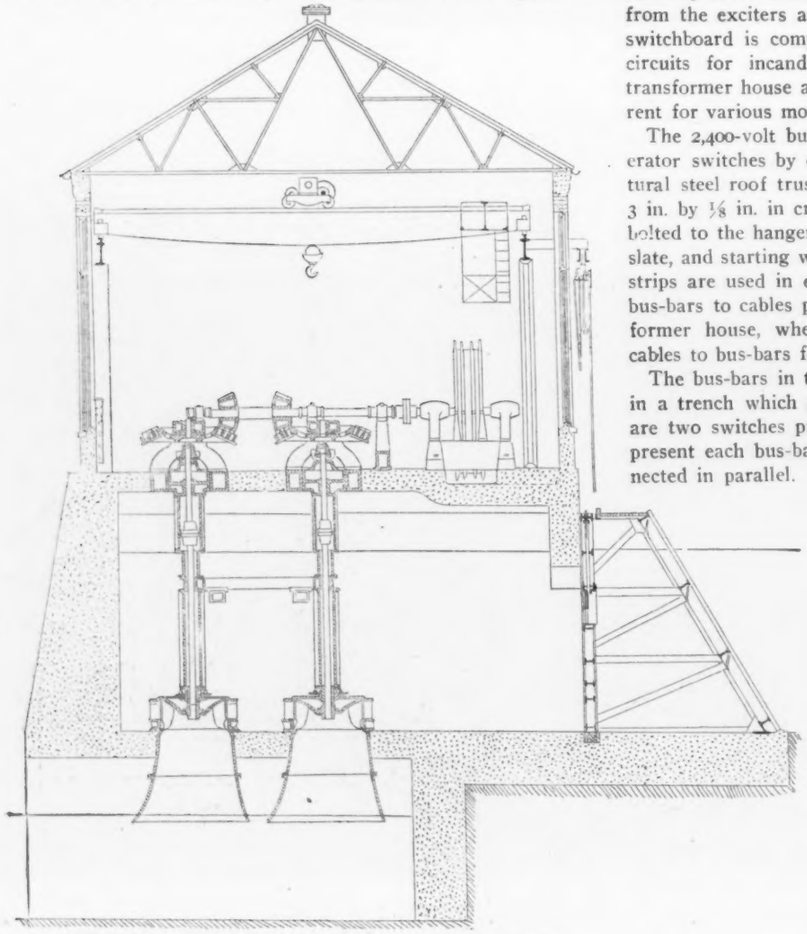


FIG. 7.—CROSS-SECTIONAL ELEVATION OF POWER HOUSE.

The 2,400-volt bus-bars are suspended directly over the generator switches by channel iron hangers attached to the structural steel roof trusses. The bus-bars are of bare copper strip 3 in. by ⅛ in. in cross-section and rest on porcelain insulators bolted to the hangers. The busses are supported by barriers of slate, and starting with two strips increase until at the end nine strips are used in each bus. Large knife switches connect the bus-bars to cables passing through the cable alley to the transformer house, where a similar set of switches connects the cables to bus-bars feeding the step-up transformers.

The bus-bars in the transformer house are insulated and run in a trench which passes under the large oil switches. There are two switches provided for each bank of transformers. At present each bus-bar has two cables of 1,000,000 cir. mils connected in parallel. When the station is complete there will be four cables for each bus. There are three banks of transformers with three transformers to each bank. Each of these is of 1,400 kw capacity, oil-insulated and water-cooled, and steps up the voltage from 2,300 to 23,000. By means of the large switches any bank of transformers may be put on either low-tension bus. These switches are three-pole, single-throw and are now being replaced by large motor-operated, remote-control, automatic circuit-breaker switches. These latter will be controlled from a small board to be erected near the switches. The other switches will be removed to the new sub-station now building outside of the City of Harrisburg, Pa.

Each bank of transformers is provided with three ammeters on the low-tension side. The high-tension bus-bars are of ⅝-in. bare copper rods supported on regular line insulators and spaced 36 in. apart on supports of heavy wooden scaffolding. There are two sets of

bus-bars and aluminum knife switches, which, of course, are not operated under load, permit any bank of transformers to be thrown on either high-tension bus. A similar equipment of knife switches allows any line to be put on either bus-bar, so that two distinct systems may be operated, or the whole system may be operated in multiple. Each line is provided with three-pole, high-tension, oil circuit-breaker switches, and has ammeters with high-tension current transformers to indicate the load in amperes.

The lightning arresters and impedance coils are located in the transformer house and are of the S. K. C. air-gap type connected in series multiple with a water resistance in series, as shown in Fig. 9. Similar arresters are located in the sub-stations and in the cable house across the river, except that the equipment at the York Haven transformer house has a carbon high resistance shunting about half the gaps and water resistance, and also has a high resistance between the three lines, thus making it a more sensitive equipment, and, as the high-tension lines are provided with circuit-breaking attachments in the transformer house only, the tendency is to concentrate all the high-tension troubles at this point and not in the sub-stations.

From the transformer house at York Haven there is a single wood pole line running to York, carrying two three-phase lines of No. 1 hard-drawn copper wire. The poles are spaced 50 to the mile and the lines are arranged in the form of an equilateral triangle with the apex at the bottom and are spaced 36 in. apart. On a cross arm below are two telephone circuits with transpositions every third pole, the high-tension lines being transposed every 3 miles. The telephone line is remarkably free from noise and has given excellent service. Each pole is set 6 ft. in the ground and is 40 ft. long with a diameter at the top of 8 in. The top cross arm is 4 in. by 5 in. by 12 ft. long and the lower cross arm is 4 in. by 5 in. by 9 ft. long. All the cross arms are well braced with angle braces and all corners are well guyed and anchored. Where the line changes direction double cross arms and double pins are used so that the possibility of trouble is reduced to a minimum. Each circuit is capable of transmitting 5,000 hp, thereby giving to the pole line a combined capacity of 10,000 hp.

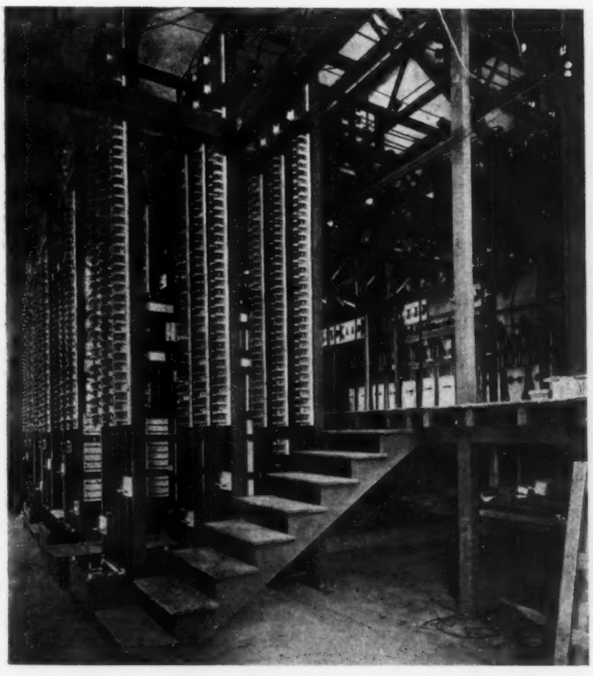


FIG. 9.—LIGHTNING ARRESTER EQUIPMENT IN TRANSFORMER HOUSE.

At the York sub-station the lines enter the building through 12-in. terra cotta pipes slanting upwards toward the inside. The high tension bus-bars in the sub-station are of ½-in. copper rod and are supported on regular line insulators, as shown in Fig. 13. The current passes to the oil switches, which are similar to the ones in the transformer house at the power station, except that the circuit-breaker attachment has been removed, and taps to the aluminum knife switches are of heavy rubber covered cable. These switches are operated with a special pole and may be opened or closed with perfect safety, while the attendant stands on the cement floor. There are two sets of high tension bus-bars in the sub-station which may be run separately or in parallel to either bank of transformers. Two banks of three transformers each step down the voltage from 23,000 to 2,400, and each transformer has a capacity of 800 kw and is oil insulated and water-cooled, the water being obtained from the city mains. The connections are such that either bank may be connected to the No. 1 or No. 2 set of low tension bus-bars through a 1,500-ampere oil switch, or they may be paralleled. The low tension bus-bars are insulated and run in a trench to a room under the switch-

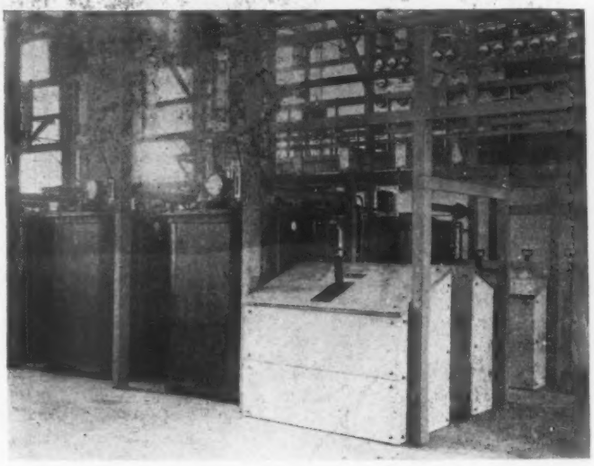


FIG. 10.—WATER-COOLED TRANSFORMERS IN YORK SUB-STATION.

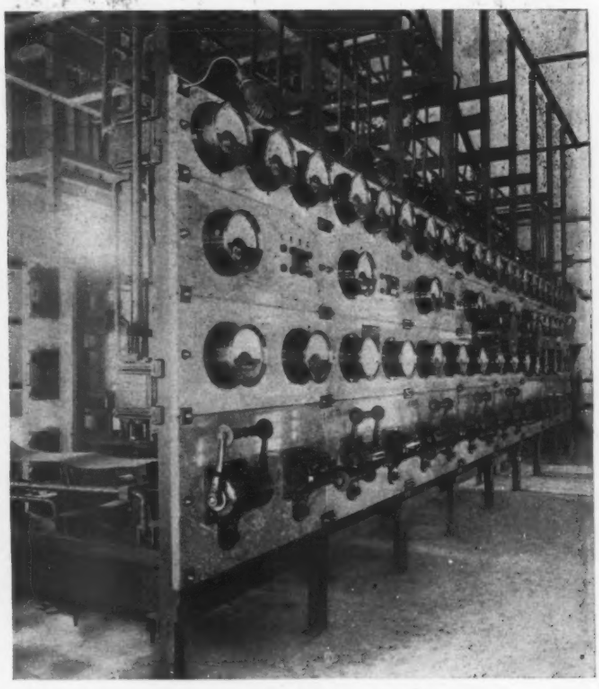


FIG. 11.—SWITCHBOARD IN YORK SUB-STATION.

board gallery, passing thence to the ceiling, where they are supported by hangers directly under the switchboard. Taps are passed up through the floor through porcelain tubes to three-pole, single-throw switches which are equipped with automatic circuit-breakers.

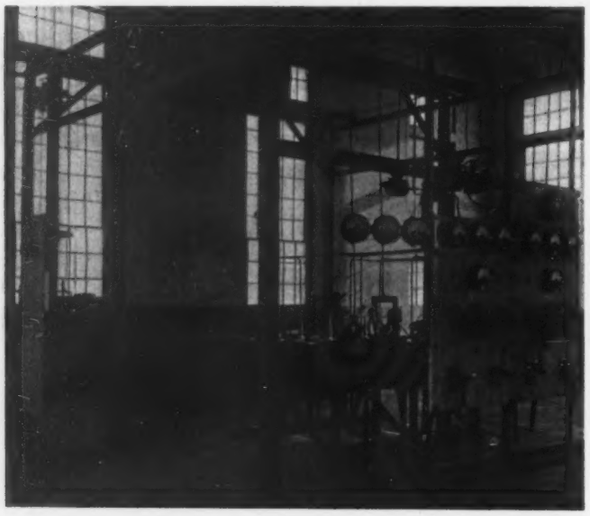


FIG. 12.—SWITCHBOARD IN MIDDLETOWN (PA.) SUB-STATION.

The switchboard at the York sub-station is shown in Fig. 11. It is made up of eight panels, five of which supply the feeders through the city with three-phase current at 2,400 volts; one panel supplies the street railway system and another the city lighting system, both arc and incandescent through the Edison Electric Light Company. Three panels supply feeders to

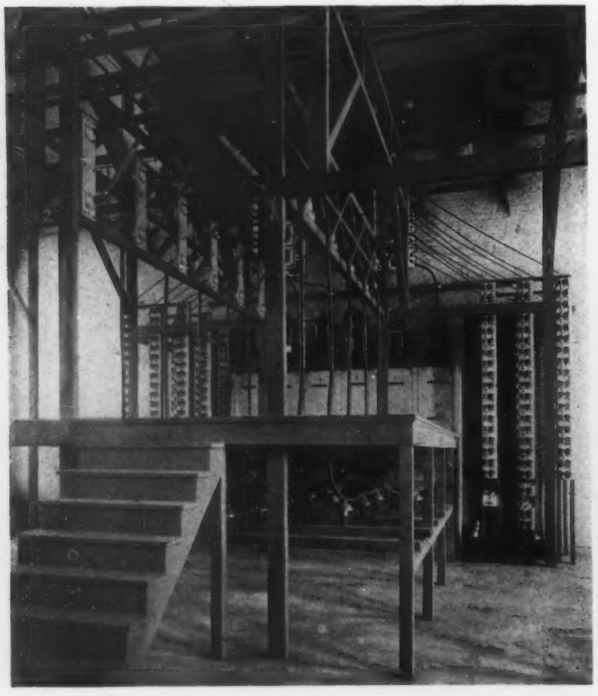


FIG. 13.—LIGHTNING ARRESTERS IN YORK SUB-STATION.

different manufacturing concerns. Each of the five panels has three 400-ampere ammeters; one voltmeter with plug to ascertain the voltage on any phase; two kilowatt-hour meters so connected as to indicate the total load on the feeder, and two three-pole, single-throw oil switches by means of which the circuit may be thrown on to either bus. There are two total-izing panels each containing three 1,500-ampere ammeters, three voltmeters, two static ground detectors and two single-phase Stanley watthour meters. There is also one panel for station incandescent lighting with switches for six circuits.

The sub-station at York is built of brick and is fireproof throughout. It is equipped with a supply room, work room and office. Sufficient space is provided for additional transformers as needed.

Located across the river from the power house, and some six miles up from York Haven, is the thriving City of Middletown, while six miles beyond this is the City of Harrisburg. Between these two places are several extensive manufacturing plants, where the consumption of power is considerable. A terminal house was therefore built on the bank of the river directly opposite the power house from which circuits lead to Harrisburg, Middletown, Columbia, Marietta, Spring Grove, Steelton and Hanover. For these lines it was necessary to cross the Susquehanna River with 23,000 volts, and it was finally decided to use cable laid in the bed of the river. From the transformer house two three-phase power cables and one three-circuit telephone cable extend across the river to the cable house, about 3,500 ft. distant. Each high tension power cable is composed of three stranded copper cables, rubber insulated, spiraled and enclosed in a solid rubber tube which is protected by jute and armored with heavy steel wires, the latter being again covered with jute and impregnated with a waterproof compound. No lead covering whatever is used, and the finished cable is 3½-in. in diameter. From the cable house one three-phase line of No. 00 hard drawn copper wire runs to the sub-station at Steelton, taps being taken off from this line for the Middletown sub-station. At the Middletown sub-station is a bank of transformers, each of which has a capacity of 250 kw; a lightning arrester equipment and a two-panel switchboard. Each panel of the switchboard has three 400-ampere ammeters, one polyphase indicating wattmeter, two two-pole, open-circuit time limit relays; one polyphase watt-hour meter, and two switches for throwing the feeders on to either bus-bar. On an addition to the top of one panel are two two-wire, 2,400-volt, static ground detectors connected three-wire. A swinging arm carries three voltmeters with plugs and receptacles on each panel.

The sub-station at Steelton is similar to the sub-station at Middletown, with the exception that the transformers are each of 800-kw capacity. Views of both of these sub-stations are given herewith.

The company supplies about 650,000 to 750,000 kw-hours of electrical energy to the Edison Electric Light Company at

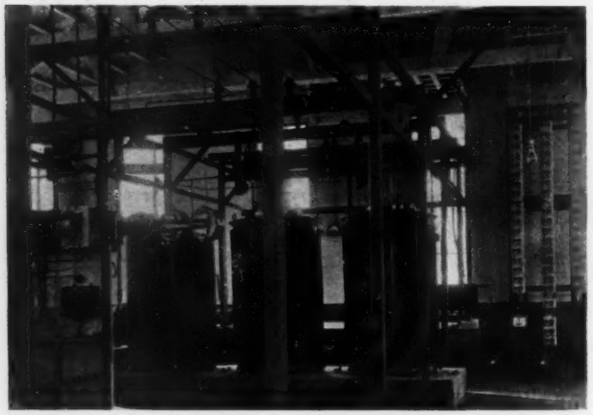


FIG. 14.—TRANSFORMER EQUIPMENT IN MIDDLETOWN SUB-STATION.

York, Pa., per month, at a rate which averages about $65 per hp-year. About 85 per cent of all the manufacturing companies in York using electric power in any quantity are supplied by the York Haven Water & Power Company direct from the York sub-station, the connected load in York being about 6,500 hp. Nothing less than 25 hp is connected to the

company's lines in York, the Edison Company supplying such customers. At Steelton there is a connected load of 500 kw with an additional load of 1,500 kw for the Pennsylvania Steel Company's plant. This latter is used 24 hours a day. The load contracted for in Harrisburg, chiefly by the Harrisburg Light, Heat & Power Company, which already has two steam stations operating in Harrisburg, is between 3,000 and 4,000 kw. The load carried by the Middletown sub-station is 600 kw.

The rate for 10-hour power varies from 1½ to 2 cents per kw-hour and for 24-hour power the rate is one cent per kw-hour. The rate for very large consumers is 8 mills per kw-hour, and this is the rate at which the Harrisburg Light, Heat & Power Company will be supplied when the line to Harrisburg is completed. The load carried is, for the main part, motor load. As stated before, the system is 60-cycle, delta-connected from one end to the other. There are a number of synchronous motors connected to the lines, special inducements being made occasionally for such motor load, with the result that the power factor of the system ranges from 90 to 95 under regular conditions. A voltage regulation of 2 per cent is constantly maintained.

The company has just completed a new office building adjoining the power house. This is equipped throughout with electricity for lamps, heaters, cooking devices and motors. An immense electric sign will be put up, and since the lines of the Northern Central Railroad, a branch of the Pennsylvania Railroad running from Sodus Point, N. Y., to Baltimore, Md., through Harrisburg, pass the station, this sign will have a great advertising value. The general manager of the plant is Mr. Edwin F. Baker, and owing to his energetic abilities the entire output of the station has been sold so that work will shortly be commenced on the other half of the station, the foundations and wheel pits for which are already in place. The ultimate capacity of the plant will be 20,000 hp. The officers of the company are George Poole, president; E. Ivans, vice-president; H. G. Nes, secretary and treasurer; and E. F. Baker, general manager.

Illumination of the "Boston Herald" Building.

The proper illumination of the plant is one of the important factors of success of a modern newspaper, especially as much of the work must be performed under artificial light. The recently completed installation of the Boston Herald Company

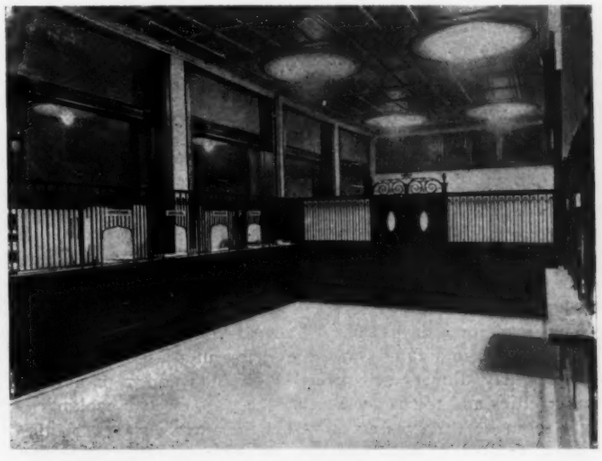


FIG. 1.—COUNTING ROOM, BOSTON HERALD.

is an excellent example of modern practice in such artificial illumination. The lighting of the large rooms of this plant is accomplished by the use of arc lamps, the installation having been planned by the Illuminating Engineering Department of the General Electric Company in collaboration with the manager and engineer of the Boston Herald Company.

Newspaper work presents four general classes of illumination: First, business offices; second, reportorial and mailing rooms; third, typesetting and linotype department, and fourth, press room.

The business office demands an ornamental installation capable of producing a strong illumination free from dense shad-

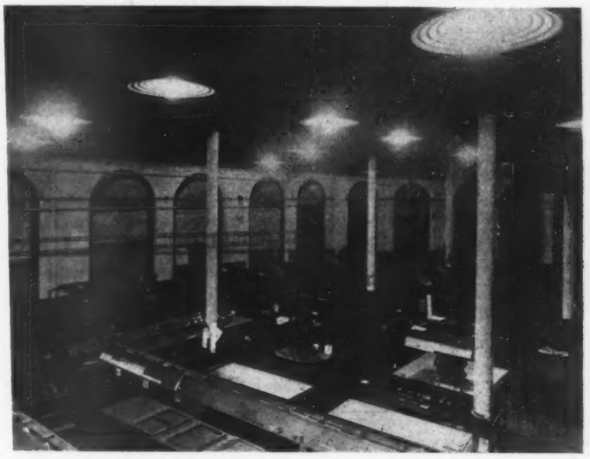


FIG. 2.—BOSTON HERALD COMPOSING ROOM.

ows. In the case under consideration, this was obtained by the use of the high-current enclosed arc lamp with a light balancing selective diffuser ceiling. The appearance of the office at night as illuminated by this system is shown in Fig. 1, which was taken without the use of any extraneous light. The lamps each consume 6½ amperes of direct-current at 110 volts. The room is flooded with a soft even light so that there is no difficulty in reading in any part. As the light sources are large and of a low intrinsic brilliancy, no uncomfortable blinding effect is experienced, even when looking directly at the lamps.

In the reportorial rooms news is received, classified and put in readable form. It is a large open office, well filled with desks. All the desks must be illuminated so as to facilitate rapid work without eye-strain. In the mailing room, newspapers are received from the press rooms, counted and marked for distribution. These rooms have about 11-foot studding and are lighted by 5-ampere direct-current multiple enclosed

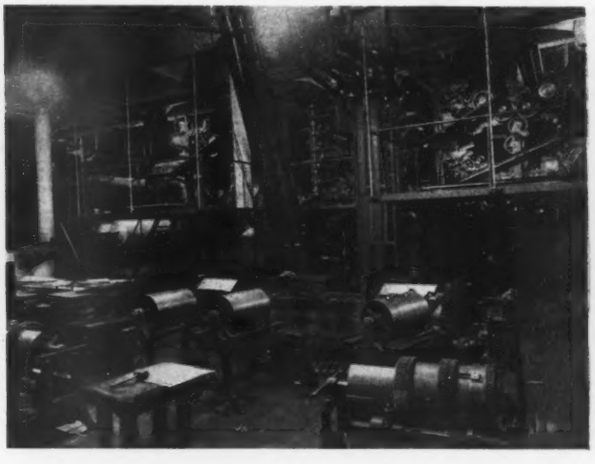


FIG. 3.—BOSTON HERALD PRESS ROOM.

arc lamps with concentric light diffusers. The lamps are hung as high as possible.

Typesetting and linotype requires especially good light in order to permit the operators to read type rapidly. The metal faces have dark dead surfaces without any color contrast, and the type is reversed, making it quite difficult to read even under

the best conditions. The illumination has been accomplished by the use of a large number of 5-ampere enclosed arc lamps. Owing to the height of studding, inverted diffusers are used. With this combination it is possible to hang the lamps quite high, concentrating the light downward and producing a strong even illumination, free from glare. Fig. 2 shows the arrangement of the room and the effective illumination produced.

Perhaps the most difficult department in which to obtain a satisfactory general illumination is the press room. While the general illumination is not required to be as strong as in the typesetting department, the presses extend up to about three feet from the ceiling, and the room is so filled up with overhanging platforms, rolls and other machinery, that it is very difficult to avoid dense shadows. By the use of the enclosed arc and the inverted diffuser, very good results have been obtained. The light has been projected into the machinery, so that the use of small incandescent lamps has practically been dispensed with. The illumination of this room is illustrated by the accompanying night photograph, Fig. 3.

Some seventy-five enclosed arc lamps are required to illuminate the various departments of the *Herald* plant. These, with incandescent lamps in the smaller offices, halls, etc., make the establishment one of the best lighted in the United States.

Experiences with Electric Cooking.

Believing that it is the duty of those identified with the central station industry, to begin the collection of data and practical experience obtained from the common every-day use of electric cooking in the home, Mr. J. R. Cravath, western editor of the Electrical World, undertook to keep exact rec-

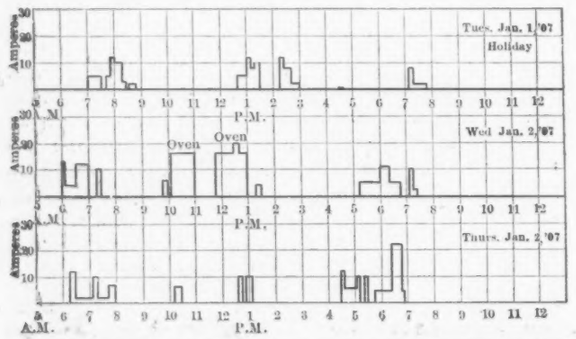


FIG. 1.—RECORDING AMMETER RECORD FOR ELECTRIC COOKING OUTFIT.

ords on electric cooking at his home in Chicago for the month of January, 1907.

During the 30-day period from January 1 to January 30 covered by the test, all of the cooking, baking and ironing was done electrically. The family varied so in size that for exact information as to the number of persons cooked for, the figures given later should be consulted. Hot water for washing and general domestic purposes was supplied from a hot-water drum in the house-heating furnace.

From January 1 to 6 the conditions were typical of those existing in the majority of Chicago families that are to be considered as possible electric cooking customers. Unfortunately for the test, the rest of the month conditions were decidedly abnormal on account of sickness in the family which called for no less than 26 extra meals or portions of meals besides the regular 3 meals a day for the family and considerable other extra cooking and baking. For this reason, in all of the following, the records for the period of January 1 to 6 are given as well as those for January 1 to 30 for the reason that the first six day period is considered as more representative of usual conditions in a family of this size than the entire 30 days. Besides sickness in the family, another disturbing element in the test after January 6 was the absence of the man of the house from a large number of meals. This resulted in shifting of the dinner from evening to midday and other irregularities in meal hours which affect the recording ammeter records which were kept, and tend to render those taken the latter part of the month valueless for drawing conclusions as to typical conditions.

The following are some of the principal figures of interest: Total kw-hours for 30 days, 137. Kw-hours for normal period, January 1 to 6 (6 days), 24.4. (This is at the rate of 122 kw-hours per month.) Kw-hours per day for month, 4.5. Kw-hours per day for first 6 days, 4.06. Number of dishes cooked during 30 days, 288. Number of regular meals (3 meals per day) served during the month, 90. Number of regular meals served during first 6 days, 18. Number of irregular or extra meals or portions of meals, 26. (As irregular meals were counted meals or portions of meals not included in the regular 3 meals per day cooked for the family.) Total number of meals, regular and irregular, 116. Number of regular meals served during first 6 days, 18. Irregular meals during first 6 days, none. Average number of persons per regular meal per month, 3.9. Average number of persons per regular meal first 6 days, 4. Number of individual meals served during month, 351. Kw-hours per regular meal per person per month, .39. Kw-hours per meal per person for the first six days, .35. Kw-hours per meal, counting total number of meals, regular and irregular, 1.18. Kw-hours per regular meal, 1.52. Maximum demand shown by Wright demand meter, 2 kw. Maximum demand shown by Bristol recording ammeter charts, 3.2 kw. (This 3.2-kw peak occurred for 7 minutes about 8 a. m., January 5. It does not occur at any other time during the month. It was caused by using the oven and several other appliances at the same time.) Maximum demand during station peak or between 5:30 and 6 p. m., 1.3 kw. Load factor with 1.3 kw as a maxi-

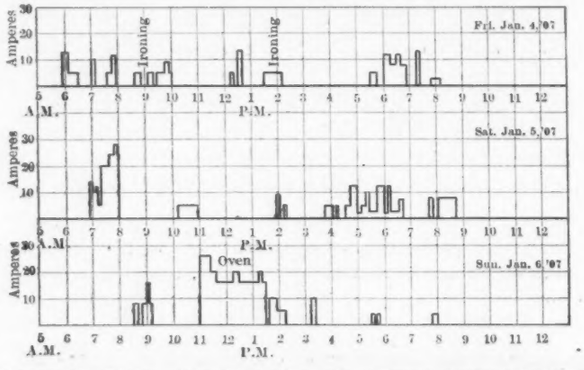


FIG. 2.—RECORDING AMMETER RECORD FOR ELECTRIC COOKING OUTFIT.

mum, 14 per cent. Load factor with 2 kw as a maximum, 9.5 per cent. Number of times oven was used, 27. (The abnormal conditions are shown by this figure, as the average family will hardly use an oven on the average of nearly once a day for a month. This was caused by the necessity for special cooking, as before explained. As the oven is the biggest energy-eater of the whole collection, its frequent use of course makes the total consumption for the month above normal.)

In Figs. 1 and 2 are curves plotted from the Bristol ammeter charts for the first 6 days of the month. This includes one holiday and one Sunday, and shows the regular week-day cooking load for 4 days. The curves shown are typical of normal conditions in a family of three to five in a large city where the week day dinners are served between 6 and 7 p. m. In smaller cities and towns (where, by the way, electric cooking is likely to make the greatest progress the next few years) the principal meal is at noon and the cooking demand in the evening is insignificant.

The point of most interest to the central station company of a large city in connection with these cooking load curves is the demand during the station peak load period between 5:30 and 6 o'clock. In the smaller towns the load curve would be entirely different as just explained. From the curves shown, as well as from the other data, it is safe to say that for a cooking installation of this kind, the maximum demand between 5 and 6

in the evening will almost never exceed 1.3 kw, while the average maximum or the average of the maximums of a number of such installations taken collectively would be considerably less than this. As it is, the collective, or total demand between the hours of 5 and 6 rather than the demand of one individual customer on one day in which the central station is interested, it would seem that in making estimates on rates for cooking, we should consider that the maximum demand between 5 and 6 for cooking will not be over about 0.7 or 0.8 kw per customer. Just what this average maximum will be, can be determined later when the records of a month or two of ordinary cooking routine, are available, so that the demand at this hour of the day can be averaged and thus the probable demand of a number of customers taken collectively can be arrived at.

When it comes to the question of transformer and distribution system capacity to take care of this load, it is evident that the assertion sometimes made that cooking apparatus will require no additional investment in lines and transformers is not in accordance with the facts. Even if none of the cooking load came on during lighting hours, much greater transformer capacity would have to be provided to take care of this house than is provided simply for the lighting. For example, the maximum lighting demand in this house is from 2 to 4½ amperes

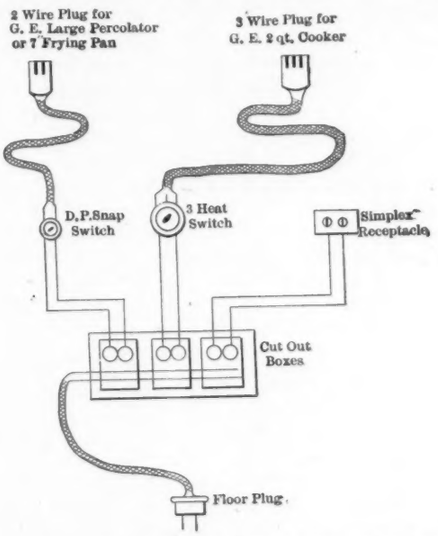


FIG. 3.—DIAGRAM OF DINING-ROOM TABLE CONNECTIONS.

while the maximum cooking demand is shown to be as high as 28 amperes, although the two maxima are never simultaneous. Considering this house by itself, a transformer for both heat and light capable of supplying about 15 amperes is necessary. One supplying 3 amperes would be ample for the lighting demand.

As to the primary distributing circuits in a residence district, probably no additional investment over that needed for existing lighting loads would be required, because in a residence district so little light is required during the day that unusual line losses would be permissible for the brief periods when heavy cooking loads in several residences might overlap. Furthermore, the cooking operations (except baking) require such a short time that the heaviest cooking loads during the day are not likely to overlap to any extent. The electric oven takes by far the greatest amount of energy of any of the devices and is on steadily for a longer period than any of the others with the exception of the iron. Nevertheless, the time at which baking is done differs so much in different houses that the overlapping of these loads is not likely to necessitate much extra investment in primary distribution lines.

If we assume that in a large city there is an investment in station main transmission lines and sub-stations of $300 per kw and that the fixed charges are 12 per cent on this, and if we charge such an installation with a maximum demand during the peak of .8 kw, this cooking installation should pay $2.40 per month to cover fixed charges on generating, sub-station and transmission equipment. It should also pay fixed charges on transformer, secondary line copper, and meter equipment of about 1.3 kw. This latter is based on the assumption that such an installation can be taken care of by a transformer capacity of 1.3 kw in excess of the capacity required for lighting. In this case a 1.7-kw transformer capacity is assumed to be necessary for the heating circuit together with the lighting, as 4 kw was more than ample for the lighting load.

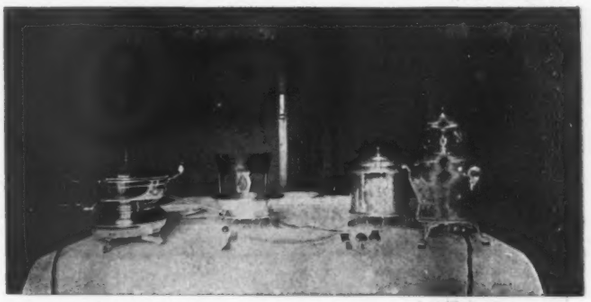


FIG. 4.—DINING-ROOM TABLE WITH ELECTRIC COOKING DEVICES.

It is not yet safe to assume what the ratio of connected heating load to transformer capacity can safely be, as more extended figures are needed. It would appear, however, that probably the transformer capacity can be made lower in proportion than it is on lighting where a number of customers are supplied from one transformer. Most of the demands made by the cooking devices are short, and the oven is the principal thing to look out for, whereas the lighting demand covers several hours.

The average of the gas bills for this family the 8 months before electric cooking was begun, with gas at 85 cents per thousand, was $2.33. For 16 months previous to that, when gas was $1.00 per thousand, the average of the bills was $3.12. Several years ago, before gas was piped to the neighborhood the hard coal range in this family took a ton of $7.50 coal a month regularly.

For a time before, gasoline was used for cooking exclusively and required approximately $3 worth of gasoline at 15 cents a gallon every month.

COOKING DEVICES AND EQUIPMENT.

The following electric cooking and heating devices were in use:

One 2-quart combination General Electric cereal cooker, steamer and water boiler; one 8-in., 3-heat Simplex stove with 5-quart saucepan; one 7-in. General Electric 2-heat frying pan; one General Electric coffee percolator, 500 watt; one Simplex ornamental stove and chafing dish; one General Electric broiler;

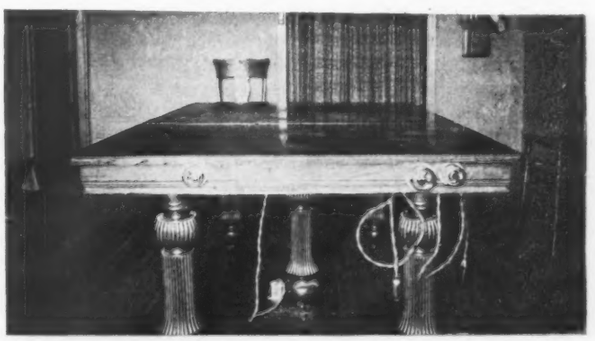


FIG. 5.—SWITCHES, CORDS AND PLUGS ON TABLE.

one General Electric oven; one Simplex 7½-lb. electric flat iron.

The chafing dish, coffee percolator, frying pan and cereal cooker could be used either in the kitchen or on the dining-room table. This is a feature to which special attention should be called and is one of the greatest points of convenience and comfort in connection with electric cooking. It is something to

which insufficient attention has heretofore been paid. We have been too prone to attempt to imitate the gas stove and the coal range and keep our electric utensils in the kitchen where the woman of the house must either hire a servant to operate them or absent herself from the table an unnecessary amount during a meal.

Fig. 3 shows the diagram of wiring of the dining-room table. The table as it appears for breakfast is shown in Fig. 4. In Fig. 5 the table cloth has been removed to show the switches, cords and plugs. Under the dining-room table are hung plugs to fit the cereal cooker or egg boiler, the coffee percolator, and the frying pan. There is also under the other corner of the table a flush receptacle, into which can be plugged the cord from the chafing dish stove. The switches controlling the extension plugs are located just under the edge of the table where they are covered by the tablecloth, but where they can be seen

FIG. 6.—ELECTRIC COOKING OUTFIT AND GAS RANGE IT SUPERSEDED.

by lifting the cloth to determine whether they are on or off and at what heat. To fully conform with National Code and city requirements, a small cabinet box with enclosed fuses was placed under the table, one cut-out being provided for each cooking utensil. The main wires from the cut-out cabinet were taken down in heavy flexible cord to a Simplex flush receptacle placed in the floor. A hole is cut in the rug under the center of the table for the plug which fits into this receptacle. This cannot be pried open and short-circuited by children as can many of the other flush receptacles.

The possibility of having the cooking devices on the dining-room table in this way in a small family or in one where all of the cooking is not done by servants is one of the strongest arguments in favor of electric cooking. It is to just such families that electric cooking must look for its first introduction. The average family gets breakfast in a hurry and without very much elaborate cooking. With this arrangement, it is easy to cook a fairly substantial breakfast without leaving the table. The cereal, if one is cooked, will usually be cooked in the kitchen before breakfast. The cereal cooker is brought on the table just as it stands, since it is clean and ornamental, and there is no need of changing the cereal into a cold dish. When the time comes to boil eggs, the inner part of the cooker is taken out, the cooker is attached to the dining-room table plug for four or five minutes, and the eggs are done. The chafing dish is available for any one of dozens of dishes, and when the stove is not in use for the chafing dish it can be used for making toast. The coffee percolator is filled in the kitchen and brought on to the table before breakfast and the coffee is percolated on the table. Another good thing about the dining-room table arrangement is that when dishes are cooked in the kitchen and when in danger of getting cold, they can be kept warm while standing on the table.

In the kitchen there was not room to install conveniently any of the regular ranges or cabinets made by the manufacturing companies. A shelf of the owner's design (shown in Figs. 6 and 7) was therefore put in one corner of the kitchen for the electric cooking utensils. In some respects the arrangement of this shelf, the owner believes, to be superior to that of some of the regular tables or cabinets which involve the use of flexible cords among the cooking utensils on top of the table. The switches, fuses, cut-outs and cords are all located underneath this shelf, the circuits of which are shown in Fig. 8. The

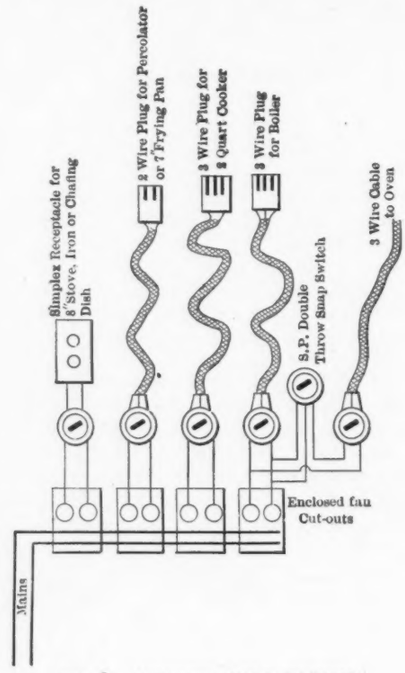

Simplex Receptacle for 6 Stove, Iron or Chafing Dish
2 Wire Plug for Percolator or 7 Frying Pan
3 Wire Plug for 8 Quart Cooker
3 Wire Plug for Boiler
S.P. Double Throw Snap Switch
3 Wire Cable to Oven
Enclosed fan Cut-outs
Mains

FIG. 8.—KITCHEN SHELF CIRCUITS.

main circuit is brought up to three branch cut-outs located in a locked cabinet box underneath this shelf. On the front of this cabinet box is a switch for each cord circuit. One of these circuits terminates in a flush Simplex receptacle to which any of the Simplex devices can be attached. The cord for each switch comes out of the cabinet box immediately under its switch. The same circuit and cut-out supplies both the oven and the broiler and a double-throw switch is provided so that the oven and broiler cannot be used at the same time so as to cause an excessive maximum demand. They are practically

FIG. 7.—ELECTRIC COOKING SHELF WITH CONNECTORS HUNG UP.

never needed at the same time. This double-throw switch is located between the three-heat switches controlling the oven and broiler. It is simply a 20-ampere Hart 3-point switch, connected in one leg of the circuit, and so installed that when its handle points toward the oven switch the oven is on and when

it points to the broiler switch the broiler is on. The cords have attached to them near their terminal plugs little rings by which they are hung on hooks just underneath the front edge of the cabinet. This arrangement is believed to be better than having cords lying on the table under the cooking utensils while cooking is going on, because it sometimes happens that things boil over on the table and wet the cords. Of course, the cords will get wet with this arrangement if water drips from the edge of the shelf on to them, but this is not as bad as having them actually lying in the water on the top of the table, since but a small portion of the cord can be wet by drippings.

ADVANTAGES AND DIFFICULTIES.

The specific advantages over other methods of cooking are in part summarized as follows, although there are many good points that might well be elaborated more fully:

1. Considerable cooking can be done on the dining-room table, as before mentioned. This appeals strongly to those who are doing light housekeeping or, in fact, to any family where the lady of the house does part or all of the cooking. Unless cooking can be done on the table she is likely to be absent in the kitchen during part of the meal, especially at breakfast, when time is limited.

2. Vegetables cooked in the kitchen for dinner can be brought on the dining-room table in the original dish in which they were cooked. This means a saving in time and saving in dishwashing, to say nothing of the fact that the food remains hot better than if put into another dish.

3. The heat given out during cooking is not enough to raise perceptibly the temperature of either kitchen or dining-room. Consequently it is the ideal method of cooking for hot weather. The average kitchen is too hot to work in comfortably most of the time while cooking is going on.

4. No products of combustion are thrown out into the air of a room, as in the case of a gas stove. The air in the kitchen is noticeably better with electric cooking than with gas. There is none of that smell of the products of combustion so noticeable in a kitchen where a number of open gas flames are burning.

5. The rate of cooking can be definitely and quickly regulated as it cannot be with coal or gas. This is specially valuable in boiling food which will stick to the bottom if boiled too hard. With care, certain breakfast foods can be cooked without using a double cooker—a feat practically impossible without constant attention with gas. Electric cooking utensils can be made to give the desirable slow heat more like that of a hard coal fire than gas, but the electric devices are under better control than the coal fire. This makes it easier to cook food at the proper rate without having it overdone in one place and underdone in another.

6. Electric cooking utensils are much pleasanter to wash than pots and pans used in cooking over gas or coal, as there is no soot to wash off. The dishwashing is therefore not as disagreeable.

7. There is no flame to be blown out by the wind and cause danger of explosion or trouble with the flame catching back, as in the case of gas and gasoline. This means that the breeze can be allowed to blow through the kitchen in summer as it could not be if gas or gasoline were used.

8. There is practically no fire risk with electric cooking utensils as there is with coal, gas and gasoline.

9. The cost with a rate of 6 cents per kw-hour will not be over that of a hard coal range, and it is incomparably more convenient than any kind of coal fire, for which coal and ashes have to be handled and fires built.

The advantages of the electric iron are already well known. There are some difficulties in connection with the introduction of electric cooking which it is well for those in the business to thoroughly understand and be prepared to meet.

A full electric cooking outfit for the kitchen costs more to install than a gas range to do the same things, although as to the dining-room table end, there can be no comparison, because gas is out of the question there.

There is also no question but that at any rate above 3 cents per kw-hour, gas at $1 a thousand is cheaper than electricity for cooking, considering only the monthly gas bills versus the monthly electric bills, and leaving out of account the fact that things can be done with electricity that can not be done with gas.

When it comes to heating large quantities of water or other liquid, the largest burners on an ordinary gas range will heat more rapidly than the ordinary electric stoves or water boilers. Either one, however, is rapid enough. The most serious problem to be met in connection with water heating is that of supplying large quantities of water for dishwashing and other domestic uses in houses where there is no other means of heating the water than the kitchen stove or range.

Another difficulty to be met in the first introduction of electric cooking is that the housekeeper is usually equipped with a large assortment of pots and pans which can be used over a gas or coal stove, so that she is not at all limited as to the number of cooking dishes. The cost of electric cooking utensils naturally will keep down the number purchased to those actually necessary; so that some housekeepers will feel that they are somewhat hampered by having so few utensils.

Taking up these difficulties in the order named, we must remember that electric light is not driving out gas on the basis of cost alone, but on account of its cleanliness, convenience and coolness. It is, therefore, entirely reasonable to suppose that electric cooking can be introduced against gas for the same reason. It is not to be expected that it will be introduced much where all the cooking is done by servants and where the house-owner looks merely at the amount of his gas or electric bills. Where the lady of the house does her own cooking and where the family income makes electric cooking within reach, it will find most rapid introduction. It will probably come in first in flats and apartment buildings for light housekeeping because of its convenience and freedom from heat and bad air.

The second difficulty—that of providing hot water—is usually taken care of in flats and apartment buildings by a hot water supply for the whole building, and in the better class of residences, by small coal or gas hot water heaters or furnace heater coils in the basement.

The difficulty of the limited number of cooking utensils disappears after the housekeeper gets used to electric cooking and learns to plan her cooking to best advantage and to get the best possible use out of the utensils she has. Cooking with ordinary enameled ware utensils on an electric disc stove is not by any means satisfactory, as it is very slow and inefficient. Utensils should either be clamped on these stoves or be constructed with the heating element in the utensil itself.

Regulation in Isolated Plants.

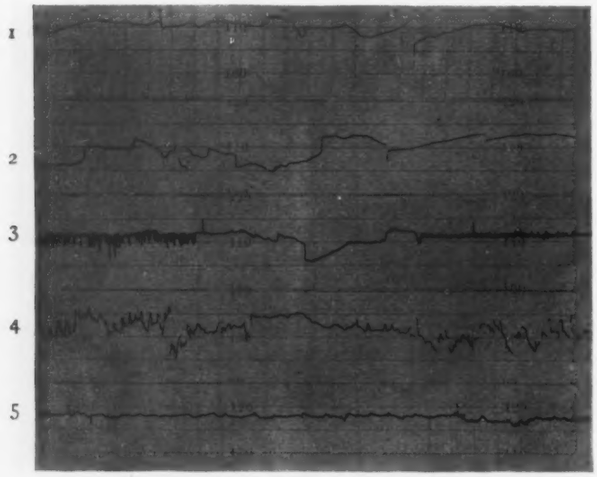
BY DR. LOUIS BELL.

THERE is no theoretical reason why a dynamo in an isolated plant should not give satisfactory regulation. Indeed, since such a plant has no distribution system of any extent to look after, it would seem at first glance that regulation ought to be rather easier than in a central station with miles of feeders and mains to keep in order. Yet as a matter of actual practice it very often turns out that the service from an isolated plant, even when run with unusual care, is actually about as bad as well could be—intolerably bad from the standpoint of the ordinary customer of a central station. The writer has recently had occasion to make voltage tests on four typical isolated plants which shall be nameless here since general facts rather than personalities are in view. The tests were made with a recording voltmeter by Eliott Bros., London, checked from time to time by a standard portable voltmeter.

Each record covered three days, and the four plants here considered were taken without any reference to their being better or worse than others, and under their regular operating conditions. There is absolutely no reason to suppose that they differ materially in regulation from the general run of city

isolated plants. The period of each record chosen for reproduction in the figure was that from 3 p.m. to 9 p.m. so as to cover the peak and a part of evening service; in other words, the period when service in the plants was in full use, and when regulation in every plant is especially important. The sections of record chosen for reproduction were neither unusually good nor exceptionally bad, and the points on the respective systems chosen for cutting in the recording voltmeter represented no extremes. In other words, the four plants were taken as thy came with the intention of getting a fair record, good, bad or indifferent as the case might be, and no other plants than those here shown were tested. A glance at the figure shows how far the regulation found was from that which ought to exist in a well-designed and operated electric plant.

Record No. 1 is from an isolated plant in a fair-sized office building equipped with some modern and some old units, but well kept up and, so nearly as the writer could ascertain, run with more than usual care and with an honest intention to give first-class service. The record speaks for itself. The voltage was fairly steady until the load came on and then sagged heavily until relieved by putting in another machine. This same conspicuous sag appeared about the same time in each



REGULATION RECORDS.

day's record. Later the voltage fluctuated some and after 9 p.m. steadied until about midnight when the variations apparently due to varying steam pressure became large.

Record No. 2 is also from a good-sized office building, which was equipped with belted units of rather old-fashioned design, but in good condition and capable of giving excellent service if properly handled. The record speaks for itself; by no stretch of imagination can it be called anything but bad, and the consumers being charged, as in the previous case, central station rates, they had a right to expect better treatment. As in No. 1, too, the later fluctuations due to steam pressure were serious, although occurring at a time when they did little harm.

Record No. 3 is an entirely different proposition, being from the plant of a popular and in other respects well-run hotel. The plant has both direct-driven and belted units, which did not appear to harmonize any too well. As the record shows, the pressure was continually oscillatory over several volts during most of the time, variations in fact taking place every few seconds or oftener, and being large enough to cause considerable annoyance. Fluctuations of such sort are enough to produce very considerable eye-strain and may be fairly termed injurious from this standpoint. The same pulsations appeared daily at about the same time, and the service, bad as it is, appeared to be the regular thing in this particular plant. That they should appear at all—let alone regularly—is a sufficient condemnation of the care taken in running the plant. Why such a condition should have been tolerated it is difficult to conceive, especially in a hotel where good illumination is generally regarded as essential.

Record No. 4 is from a plant of another sort, in an industrial building, extending its service to its neighbors as well, and carrying something of a motor load besides its lamps. It is equipped with a pair of good modern direct-connected generating sets, quite capable of thoroughly first-class service. How bad were the actual results it needs but a glance at the record to show. Up and down went the pressure in irregular jumps, varying incessantly. What kind of results the incandescent lamps gave can be better imagined than described. Yet the section of record is thoroughly typical of what the plant was doing day by day. The effect on the eyes of those who were unfortunate enough to have to work by such a light needs no comment. Yet this sort of thing is tolerated from an isolated plant, while if received from a central station it would almost raise a riot.

By way of contrast in No. 5 is given the voltage curve from central station service within the same district at an industrial plant where about 200 hp in motors were across the outside wires. The effect of this motor service is evident enough, yet as a whole the voltage is steady and even its widest fluctuations are of modest extent.

Of course, it goes without saying that a large central station with its huge generators must have a certain stability of service which it is difficult to approach in the case of a plant of small capacity, and yet this is far from being the whole story. The remarkable feature of these tests is not that the central station service should be relatively good, which was to be expected, but that the isolated plant service was absolutely so bad. One would suppose that in a single building or block it would be easy to determine the drop over the feeders and mains, and even without pressure wires to hold a fairly steady average voltage. In any event the fluctuations of No. 3 and No. 4 are so big as to be at once conspicuous in the dynamo room and should not have been tolerated for a single hour, let alone week after week. Perhaps the owners of these plants skinned the wages of firemen and engineers, or they may have been parsimonious in fuel, or many other things might have happened, but it seems to the writer that the real trouble lies deeper.

One of the ostensible advantages in installing an isolated plant is the fact that a large building has to have an engineer anyhow, part of whose time can be taken up in looking out for the electric plant without extra cost. Now it looks very much as if this sort of regulation was just about what might be expected of that sort of undivided fraction of an engineer. To keep up first-class service in a plant when the fluctuations of load are regularly a large part of the total capacity, requires plenty of copper, well-run engines and eternal vigilance at the switchboard. These are just the things that are apt to be absent in an isolated plant, in which the duties of the responsible engineer are apt to be spread out very thin indeed. To give the same unremitting attention to regulation that is necessary in central station practice requires a degree of expert care that is costly when applied to a small plant—and its cost is generally omitted in the estimates. Hence, the kind of service here recorded.

Notes from St. Louis.

As previously noted in these columns the Union Electric Light & Power Company, of St. Louis, has been doing considerable billboard lighting. This lighting is done by means of rows of lamps in tin trough reflectors placed along the top of the board. It is taken on a flat rate contract providing for a certain number of hours burning and is turned on and off by the company's patrolman, like any other sign. The following circular letter sent out by the company to possible billboard advertisers brings out the advantages of the illuminated billboard and serves to give the arguments used in soliciting this class of business:

"The Bill Board is one of the valuable mediums of publicity—We know it, because we have tried it.

"The illuminated bill board is as far in advance of the ordinary daylight board, in earning ability, as the daylight board is ahead of no board at all—We know it, because we have tried it.

"Your daylight board takes its chances with thousands of others, being effective only in proportion to its location, beauty of design, or all combined.

"The Illuminated Board, even if below mediocrity in all of the above requisites, becomes, when lit up at dusk, an isolated and hence practically the only board in its vicinity, and however modest or even poor in appearance or design, is more valuable as an advertisement than the most exquisite results of the painter's art on the adjacent board, in the dark and "Out of Business."

"The Illuminated Board gets the public eye and interest when in their most receptive conditions. The busy merchant or manufacturer, on the cars in the morning, is engrossed with his newspaper or his plans for the day; all signs look alike to his casual glance from the car window; but at night, on his way home, mind at ease, with no distractions, the flash of light from the surrounding darkness, illuminating the board of the shrewd advertiser, compels attention and makes that indelible impression which is inseparable from the conspicuous or novel in any form. You have accomplished your purpose; you have burned into his mind and memory, your name and business; your board, dormant by day, has paid for itself in the flash of a few seconds."

DRUGGISTS AS AGENTS.

The methods used by the company in securing the co-operation of druggists as agents are shown by the following circular sent out to druggists:

"We are enclosing you herewith our booklet, showing a list of trial customers, and what they pay for electric light at home. Many through carelessness, some through ignorance, and others because they labor under the mistaken idea that electricity is costly, are still using the old forms of illuminants, injurious alike to health and perfect cleanliness. With electricity at home, perfect hygienic conditions become possible, ideal housekeeping is assured, smoky, sooty draperies are impossibilities, tarnish on silver disappears, picture frames are preserved, and real economy begins.

"We desire to interest our druggists in not only using common sense light themselves, but in spreading abroad its advantages to their patrons. There will be selected, from different sections of the city, fifty druggists to act for us. We will furnish each one with a canteen light, eight inches in diameter, on one side of which the reading matter will be "Use Electric Light at Home"; on the opposite side, "Pure Drugs," or "Prescriptions," as you may choose; these we furnish free.

"We will also supply you with blank orders and an illustrated catalogue, containing a full line of electrical devices, with prices and what each costs to operate in current. On such orders, acceptable to us, which you send in, you will be credited with a commission; this discount or commission will be, approximately 20 per cent from our list price where you carry the account, and 15 per cent where we carry it on our books; the 15 per cent to be credited on your monthly bills.

With this circular was sent a return post card.

CO-OPERATION WITH DOCTORS.

Special emphasis has been put in this company's advertising literature on the benefits of electric light as against oxygen consuming illuminants in combating tuberculosis and other diseases which thrive in badly ventilated houses, quoting from Prof. Irving Fisher of Yale on causes of tuberculosis. In this connection a circular was recently sent out to doctors offering to make emergency cases of connections to any residences where electric light service was wanted upon statement of the doctor that a patient's case is urgent, and eliminate the usual course of such connection orders, except wiring inspection.

Recent Practice in Wireless Station Construction.

BY G. H. BARBOUR.

THERE has been a great deal of advance and improvement in the last few years in the means of procuring the desired height of mast or other elevation for the suspension of the antennæ wires used as radiators in wireless telegraphy. When wireless stations were first erected for experimental or commercial work the standard form of ship mast was used. These masts were made up of several pieces of long timber that were shaped up and fitted with the necessary bands or "trees" for splicing them together. In fact this form of construction is the same as that used in building a mast on a ship, except that the wireless mast is made heavier in order to enable greater lengths to be built and maintained after being erected. This form of construction has many faults; moreover, it is very expensive in first cost as well as in maintenance due to the fact that it is very hard to get the long lengths of timber required for a design of this kind. In most parts of the world these long timbers must be brought great distances by steamer, and the cost

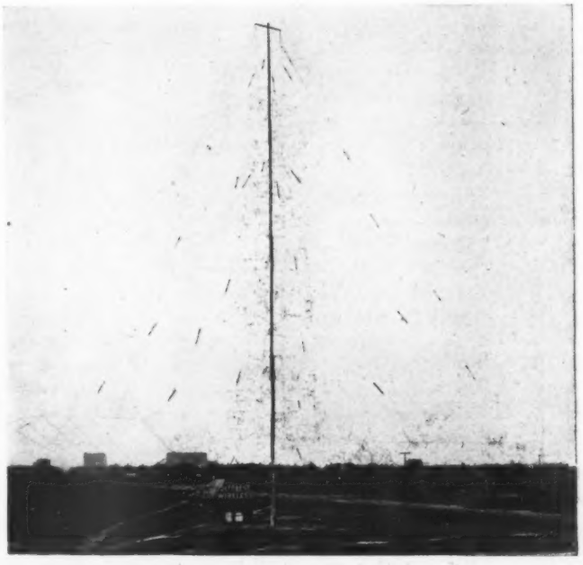


FIG. I.—MAST AT CHICAGO, ILL.

of unloading and handling these timbers is very heavy indeed. The conditions will be better understood when it is remembered that in order to get a mast say 215 ft. long by this method it is necessary to have the main mast at least 75 ft. high. The other sections required for a 215-ft. mast would be from 45 to 60 ft. long.

The handling of timber of this length to and from the ships and cars used in transporting them from the forest region is quite easy, however, as compared with landing them on the ground where they must be erected. The number of men and horses required increases the cost of handling to an enormous figure in many cases, as wireless stations are almost without exception erected at exposed points where the roads and the means of transportation are about as bad as they can well be imagined. The ground is usually rough and stony or soft and muddy and the naturally bad conditions are made worse by bad weather in many cases. The erection of this class of mast is a long and tedious process, as the mast must be raised in sections and for the operation the weather must be perfect. Thus the process of erecting a mast may extend over many days and perhaps weeks.

Each section of the mast as it is erected must be made fast before another section can be raised into position and the men must be held on the work be the weather fine or not. When

the mast is complete it has a weak place at every joint, thus necessitating a perfect alignment from one end to the other to prevent buckling at the splice points. Every case of failure of such a mast, be it a flag pole in two sections or a wireless mast of four sections, has been at these points. It is impossible to prevent the failures as the bands must be secured to the mast to prevent it from turning and the mast must be cut for this and other reasons, all of which tends to reduce the section at the weak point. Moreover, decay and depreciation due to the action of the weather is most prominent at this point.

Another bad feature of the design resides in the fact that the different sections are offset one from the other, and the mast is not straight from top to bottom. The offset will depend on the size and height of the mast and in the case of a very high

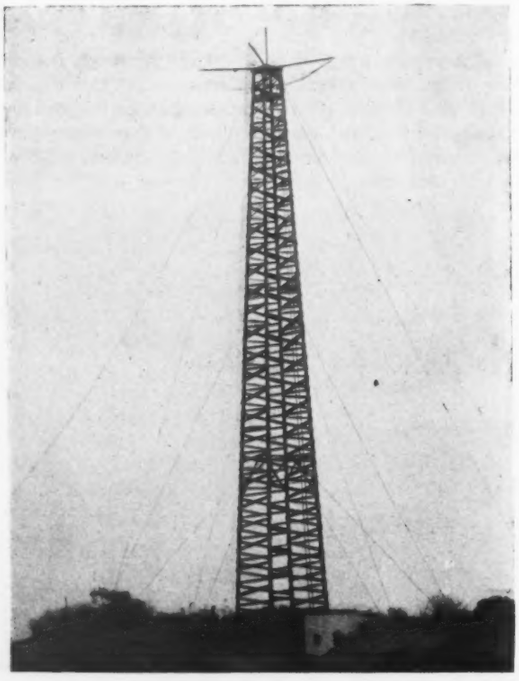


FIG. 2.—LATTICE TOWER AT CAPE HATTERAS.

mast for wireless work it may be as much as a foot and a half or more. For a single mast station where the load can be placed to help or allow for the offset the disadvantage is not prohibitive, but for a two-mast station or for a station where several masts are used it becomes a very serious problem and one that may lead to trouble from twisting of the mast as a whole. It is quite necessary for the guys of this type of mast to be made of metal rope properly fitted with insulators in order to get rid of the trouble due to shrinkage and to allow for the proper tightening up of the guys. A picture of one of these masts (Fig. 1) is given to show how the load is carried. There are several ways of overcoming the disadvantages just enumerated. One of these is by the use of towers for the procuring of the necessary height. This method is good, but very expensive, and incurs the heavy upkeep that comes from having a large amount of timber exposed to the weather, no matter how well it may be selected or framed.

It may be well to state here that the writer is not in favor of the use of metal for wireless masts or towers, as it has many bad features and is bound to act as an absorbent of energy no matter how well insulated or connected to the electrical circuit. The tests that have been made tend to prove this statement, although there may be steel towers in use for wireless work that are giving good results, better results could probably be obtained if this same height had been gained by the use of some non-conducting material.

The wooden tower has a good feature in the fact that it can be inspected at regular intervals at small expense, and any pieces that require renewal can be replaced without much trouble or expense. The above statement refers to a tower in which the uprights are made by bolting planks in such a manner that the material is equally distributed and the joints are so staggered

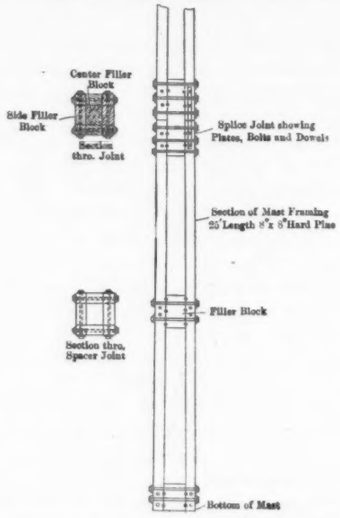

Center Filler Block
Side Filler Block
Section thro. Joint
Splice Joint showing Plates, Bolts and Dowels
Section of Mast Framing 25' Length 8"x 8" Hard Pine
Filler Block
Section thro. Spacer Joint
Bottom of Mast

FIG. 3.—DETAILS OF OPEN-WORK MAST FRAMING.

throughout the entire length that the tower is in reality one continuous piece of timber. The lattice bracing is bolted to the sides of the uprights, the structure being framed complete before it is erected. All pieces are marked and are hoisted into place one at a time and the bolts drifted into place and tightened up. This process is followed from the bottom to the top until the tower is complete.

The above method of getting the desired height has the great advantage in that the structure is self-supporting; in other words, it will stand by itself without the need of guys, although guys must be used to steady the tower against the strong winds to which it is subjected and the unbalanced load that in most cases is imposed by the antennæ. In the cast of a station consisting of a number of towers the unbalanced load is very great, and special care must be taken that the load of the antennæ is

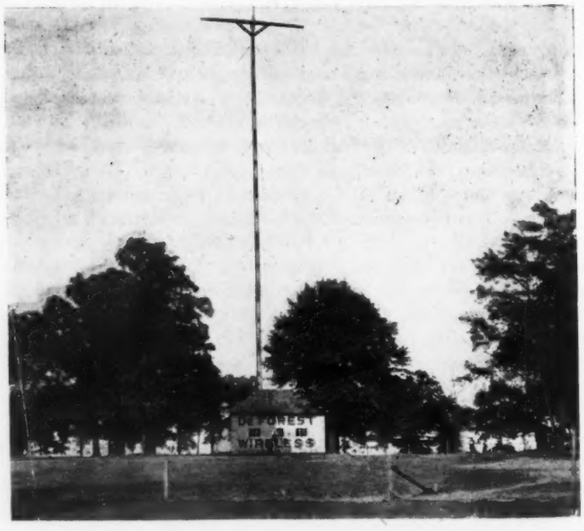


FIG. 4.—SENDING TOWER AT ST. LOUIS EXPOSITION.

supported or rather offset by means of special guys properly placed.

Provision must be made for the lowering and raising of the antennæ screen, and for this reason the tower is usually equipped with a platform at or near the top with the necessary appliances for this kind of work. The tower should also be equipped with

a means for getting to the top, ordinarily by the use of a ladder, although it might be possible to employ stairs for this purpose. It is not necessary, however, to provide an extra ladder as the tower itself can be used as a ladder, and for purposes of inspection it is possible for a man to climb all over the structure.

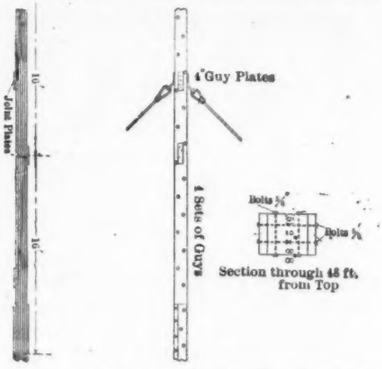


FIG. 5.—METHOD OF MAST FRAMING.

The footings and anchorage for the tower would depend on its location and the wind strains to which it would be subjected. The wind is always an unknown quantity, and therefore a very large factor of safety must be allowed. The footings may preferably be made of concrete, and the size and height should be such as to conform to the nature of the ground on which the towers are located, but the footings should be made of sufficient height to bring the legs of the tower well above the level of the ground so as properly to protect the structure from the weather.

The design of an anchorage for the structure is also of great importance, and is one that is dictated by the local conditions to a very great extent. The guys that have proved to be best for wireless work and the material used and the method of using it will be treated separately later in the article. They should be divided into sections by means of strain insulators of special design. An illustration of a tower station erected by the writer at Hatteras is shown in Fig. 2.

Another form of construction that has been aptly called the "open work mast" construction may here be described briefly. The mast is in reality a tower, from the fact that it is framed with corner posts and is braced at different points throughout its length. The sizes of the timbers used for the framing of the mast would depend on the height of the mast, the load it would be required to carry, and also on the local market for timber. One of the great features of all of these means of

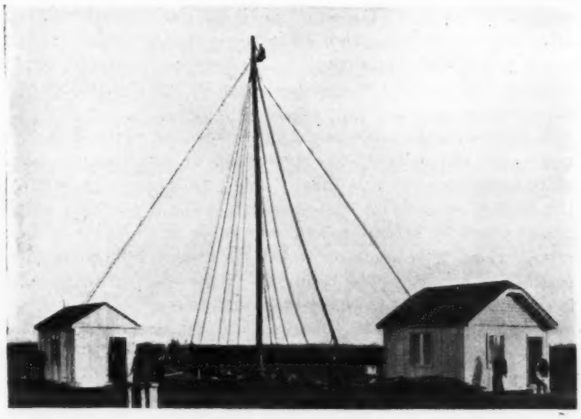


FIG. 6.—METHOD OF TRESSELING MAIN MAST TO JURY.

tower or mast building is that it can be adapted within certain limits to the local conditions as well as the local markets, provided, of course, that the right kind of material can be found locally to take the strain imposed by these loads. A good grade of Southern pine is best for the work, on account of its great strength, but where it is not procurable a slightly inferior grade may be used by making the proper allowances. It is preferable to use this material in as long merchantable lengths as possible, on account of the saving in labor and material in the making of the splices. A saving in weight can also be effected by the use of long pieces.

The mast is built by framing together four pieces of 6-in. by 6-in. or 8-in. by 8-in. timber by means of splice joints, filler blocks and splice plates, to make a continuous structure. The tower tapers from the bottom gradually to the top, and when complete can be raised in one piece. The interposition of spacer blocks into the framing is employed for stiffening the long sections of timber used so as to keep them from buckling. A sketch showing the way these pieces are framed together is given in Fig. 3 and shows the way the spacer blocks are inserted. The photograph of the high power station at the World's Fair at St. Louis (Fig. 4) also shows the framing of this style of mast except that it is preferable to have this top yard or arm arranged to raise and lower rather than to be framed as part of the mast proper. Several of this style of mast have been built, including Boston, New Orleans, the large Government stations at Key West, Colon, Guantanamo, New York, and at New Castle-on-Tyne in England.

The latter style of mast is ideal for heights up to and including 300 ft. The writer has designed a modification of this style

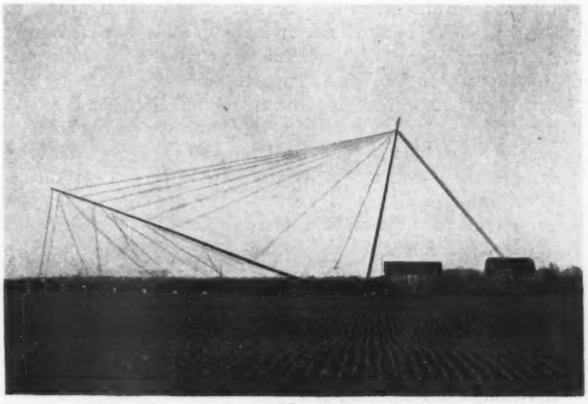


FIG. 7.—FIRST STAGE IN MAST RAISING.

of mast for the latter height that will carry an antennæ weighing several hundred pounds together with the necessary guys and the rigging for raising and lowering. He has erected several of these masts on this side of the Atlantic and in England, and they have been found to withstand their load well and to have great lasting powers due to their design and the fact that only the best of material is used.

The method of making up the guys for this kind of mast will be taken up later, but it is proper at this time to mention that it is not necessary to have the guys on this style of mast drawn up string tight; in fact, it is undesirable to do so because it is necessary merely to maintain the mast in an upright position, and any additional strain has a tendency to buckle it. It is best to determine what the load on the mast is to be, and then to guy the mast for that load rather than to guy the mast and then impose the load subsequently.

In all of the above types of mast the footing serves no purpose except for the support of the mast and is not intended for maintaining the mast in an upright position. The latter is accomplished by the guys which are distributed equally throughout the length of the mast, due consideration being taken of the strength of the different sections to resist buckling or crushing strains. One of the interesting features of the mast is found in its action in a strong wind; the mast is integral from one end to the other and for that reason has no weak points or joints as is the case with ship masts, and when acted upon by a strong wind tends to wiggle or move from one end to the other in much the same way as does a whip that is shaken.

An additional style of mast and one that is by far the best

for stations of moderate power will now be described. The first one of these masts was built by the writer at Springfield, Ill., in June, 1904, and since that time many of them have been built in the United States, Canada and England. The time taken to frame up one of the masts varies, but it is safe to say that under favorable conditions it is possible to frame and erect one in from two to three weeks. A sketch showing the way the mast is framed is given in Fig. 5, from which can be seen the manner in which the material is used. One interesting thing is that the mast can be taken apart at any point, and can be built at any desired point and transported and assembled, or it can be built on the ground and erected in sections. Moreover, in case the location of the station will admit of such a condition it can be built on the ground in one piece and erected as a whole. The latter method is the best when it can be used, as it is the cheapest and by far the quickest. The number of the pieces as well as the size is varied from one section to the other in a way to give a gradual taper with the minimum amount of work; the strength of the mast for its size is very great indeed. The matter of continuous material is carried out to a still better end than in the mast previously described, as there is no point in the mast where it can be said to have a joint, but it can be separated at any of the many points where the timbers are placed together.

The ability to take the mast apart and to raise it in sections is of great advantage, as it is best in many cases to frame the mast as a whole, but to raise it in two sections on account of the location or weather conditions which make raising a mast of that length in one piece impracticable. In order to raise the mast in two sections it is necessary merely to fit the lower part that is raised first with temporary trees or guides that will allow the upper part to be hoisted through them past the lower mast until the topmast is in its proper position and can then be dropped into place. It is necessary to guy the lower mast securely until the topmast is in place and the topmast is kept in an upright position while the lifting is being done by means of the permanent guys fastened to the topmast.

The amount of power for the lifting process is very small indeed, and, in fact the secret of success is to have a small amount of power applied very slowly and evenly, and for this reason it is best to use man power. The work of two or three men is ample for hoisting if applied properly through a back-geared capstan. As soon as the mast is dropped into place the temporary trees can be removed, and the mast then appears as shown in the picture of the completed station.

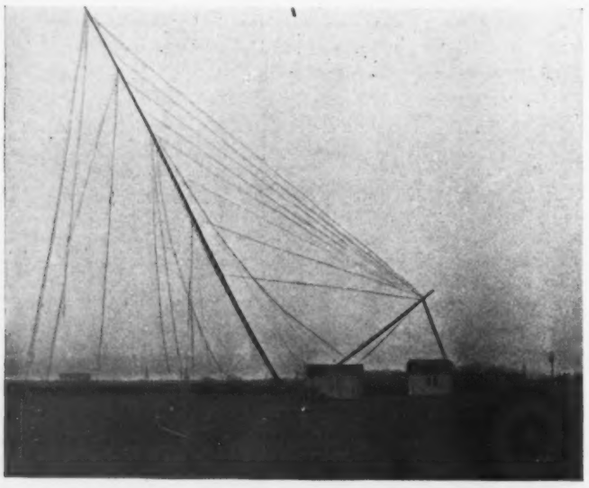


FIG. 8.—MAST NEARING THE VERTICAL POSITION.

The footing for the mast is merely a pancake of concrete to support the weight of the mast. It is made of peculiar shape to enable the lower mast to be raised into it or held by it while being raised, assuming now that it will be preferable to raise the lower mast by the method to be described later, even if it is best owing to local conditions to erect the mast as a whole in two sections.

After the mast is framed complete from end to end and the guy plates or bolts are fitted with the guys that are to support the mast after it is erected, the rigging or tresseling of the mast

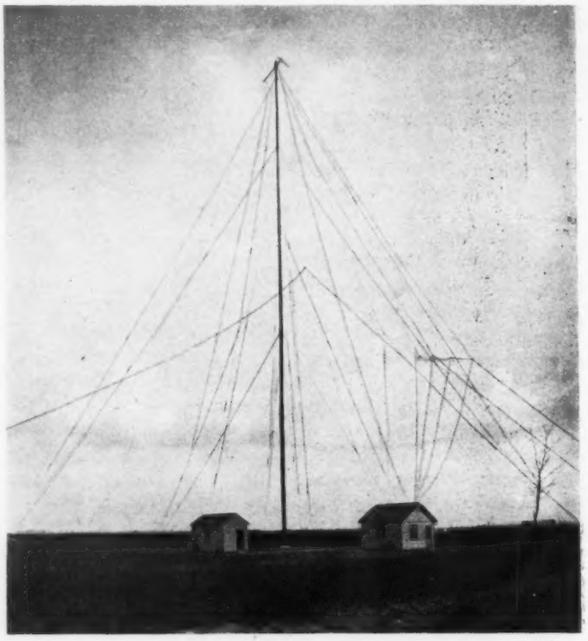


FIG. 9.—COMPLETED STATION SHOWING BUILT-UP MAST.

for hoisting should be considered. A mast which measures 200 ft. or more must be held in practically the same condition in the air during the process of lifting that it previously had on the ground and that it will subsequently have in the air after it is raised. Thus it must be tresseled with a large number of guys to the jury mast that is placed on the foot of the mast and fastened rigidly to it, as shown in Fig. 6. It is tresseled up in a way to form a rigid triangle, and the main mast is raised by pulling on one corner of the triangle. It is also necessary for the mast to be held from any side sway and kept straight throughout its entire length.

The time taken for lifting should be about one full day. The process requires perfect weather, as can be judged when the length of the mast and the amount of exposed surface is considered. The fact that only one good day is required is an advantageous feature for outside work, as after the mast is up in place and the weight is not on the jury or the tressel rigging, it is possible to lash the mast so that it will be as safe as if permanently guyed.

A mast fully rigged ready for lifting, is shown in Fig. 6, already referred to, and it is interesting to note that the height of the jury mast in this case is about 70 ft. and the length of the mast that is to be raised is 217. The proportion will be better noted by reference to the mast in the process of being raised where it is about 30 ft. off the ground at the top of the mast (See Fig. 7). The condition of the mast in this position is one of perfect alignment or as nearly so as it is possible to get with an object that will bend a great deal throughout its entire length; the same condition of alignment is to be noted also in Fig. 8, where the mast is nearing the upright position. In all of the cases strict attention is paid to the proper easing or slacking of the guys, so that no undue strain is put on any one part of the mast.

Fig. 9 shows the completed mast permanently plumbed and guyed, the antennæ rigging being on the top of the mast and the antennæ in place. It is always best so to mount the antennæ on the mast that the force of the load is vertical, or in other words so that the component of all the forces exerted on the mast by the antennæ itself with its guys and the support for

the same and the means used for raising and lowering shall be exerted in a vertical direction.

The writer has erected more than thirty stations for wireless work and at least twelve of them have been of the latter design, and none of them has been damaged by wind storms. The action of wind on a structure that is flexible for its entire length is not the same as it is on rigid bodies, because the load on the mast is not increased until the pressure of the wind from any given direction equals or exceeds the tension on the guy from that direction, and the mast itself is not affected by the motion which takes place throughout its entire length. The mast is simply a series of columns supported one on top of the other by means of a system of guys, and these points of support are also capable of a certain amount of motion that is transmitted and distributed throughout the entire length of the mast. It is quite possible for the mast to experience a movement at the top of several feet, due to the slackness of the guys.

The guys for the towers are made of metal rope, the size in each case being determined by the weight and height of the mast, and the distance the guys are placed from the foot of the mast, as well as the velocity of the wind. Turn buckles are not absolutely necessary where metal guys are used. The guys can be set at the proper tension once for all; any change required can be made by altering a shackle or drawing a splice. In order to prevent the metal guys from absorbing energy as conductors, they are cut up into short sections by means of strain insulators. The insulators are designed with the object of giving a long sparking distance for the high-tension static discharge. In some cases oil is used in the insulator for the added insulating properties that it has, but in the majority of insulators use is made of wood which may be combined with porcelain to give added insulation and protection from moisture. The length in no case should be less than two feet, to obviate the leakage that will take place over the surface in wet weather. The wood should be treated in some kind of insulating preservative to protect it from the weather. The number of insulators required for a mast would vary, but a good rule would be to subdivide the long guys into sections no greater than 70 ft.

There are a large number of these kinds of masts along the Atlantic coast line, as well as on the Great Lakes, and the writer has just erected seven of them in England; others are being erected on the Continent in connection with contracts for completed stations. The cuts showing the mast in the process of erection were taken in Cambridge, England, where the writer was engaged a year ago on construction work. There is a wide field for this line of work to be applied in the serving of isolated places with press and general news and messages from outside points. It is along the line of the above-described construction that the bulk of the communication will be carried out.

The part that wireless telegraphy is playing and is bound to play in the commercial business of the world is probably not comprehended by the average man, who has made no particular study of the subject. The progress that has been made in the last decade is greater than the progress in any other means of communication in a given length of time, and this progress, that is a sequence of the demand of the times, is steadily going on in all parts of the world.

Drying Transformer Oil.

BY R. B. TREAT.

Many articles have appeared in the technical papers of recent date laying great stress upon the importance of having transformer oil free from moisture, but none of the articles has told how this moisture might easily be removed without harm to the oil. Vacuum treatment and other elaborate methods have been hinted at.

The presence of a large amount of moisture may be indicated by plunging a red-hot spike into the oil. If much moisture is present it will be converted into steam upon contact with the spike, and diminutive explosions will be heard. Together with the faintly-heard explosions, will be seen a boiling and vaporizing of the oil itself. This latter, however, will be present in "bone-dry" oil. The test is of slight value in that the ear will not detect explosions when by other tests it is known that moisture is present. The term "bone-dry" is used with oil so dry that electrical tests will not indicate moisture.

The various oils in use for transformer purposes have properties differing markedly from each other. The designer selects an oil best suiting his particular design of apparatus and may sacrifice some qualities thought desirable by others. One property of oil which does not seem to have been considered extensively is that of holding moisture in suspension. Some oils will not hold any appreciable amount, but will throw it down to the bottom of the transformer case where it does no harm, leaving the oil in almost as dry a state as before, while other oils, perhaps the slightly more viscous ones, will hold some water in suspension and reduce the insulating value to ⅓ or ¼ that of bone-dry oil. Withdrawing the free water from the bottom of a transformer case filled with such oil does not remove the danger from moisture. Oftentimes, moreover, some unavoidable accident to the pipes of a water-cooled transformer allows the oil to become water saturated.

The best test known to the writer for determining moisture in oil is that of applying high voltage across spheres having a known separation, the whole surrounding space being filled with the oil under test. A commonly used distance between contacts is 0.15 in. A handy device for such testing consists of a vertical glass cylinder about 2 in. in diameter, a sphere ½ in. in diameter mounted on a rod projecting an inch or two up from the bottom of the cylinder. Another sphere is supported by micrometer adjustment at the top of the glass. The spheres are brought into contact and then separated the required distance; the oil is poured in and the test voltage gradually raised by, say, one or two thousand volt increments at about 30-second intervals until the oil becomes punctured.

Samples of oil procured upon the open market and tested in this manner without undergoing previous drying treatment will give surprisingly varying results and no proper value for the oil's insulating properties can thus be obtained. A recent trade write-up of one manufacturer whose oil was tested in this manner and advertised as thus being of high-class material, was indeed amusing, for how is one to know the previous history of the sample? An oil direct from the refinery which has not been exposed to weather conditions should show a high break-down test; a sample of the same oil may have stood in the rain in wooden barrels, and absorbed moisture, while another may have been stored in a dry warehouse.

Most of the recent articles upon transformer oil have led one to infer that the process of drying it is one requiring great care and some scientific knowledge. The writer wishes to dispel this impression, and therefore describes a simple method, easily applied with the minimum amount of apparatus.

Working with the initial idea that the operation was quite difficult, an apparatus of an elaborate nature was improvised and dry oil was obtained satisfactorily, but it was constantly felt that the operation must be simplified. Changes were successfully made until the method described was hit upon. The method is simply this: Warm the oil—any temperature above the surrounding air will suffice—blow air through it and dry oil is the result.

The oil may be heated to any desired temperature. Temperature higher than 80 or 100° C. tend to darken the oil by forming minute particles of carbon which, depending upon the viscosity of the oil, will be held in suspension or will be precipitated. The quantity of air blown in need be only sufficient to cause rapid bubbling.

The apparatus used by the writer was one previously designed for another purpose and consequently more elaborate than was necessary. It consisted of an iron pot entirely open at the top and having steam coils along the inner surface. Air from the compressed air supply of the plant was blown through a ¾-in. pipe, at the center of the bottom. The natural circulation of the oil assured that all received treatment.

Oil before treatment will withstand anywhere from 6,000 volts to 30,000 volts across the 0.15-in. gap, depending upon the previous history of the oil. After six hours of the air treatment the breakdown voltage will be 40,000 or more. Most oils will retain this strength if left exposed in the open pot for weeks.

The above air treatment has been applied to oil in the transformer itself. A current somewhat less than full-load value was passed through the windings, by short-circuiting the secondary and using a low-voltage across the primary, thus warming up the oil. A sheet-iron pipe was thrust from the top down to the very bottom of the transformer case, the pipe being coupled to the blower of a blacksmith's portable forge and hand power applied for a few hours. The oil was thoroughly dried and the transformer again took up its duty.

The theory, if so simple a thing may be called theory, is that air when raised in temperature will take up additional water vapor. The ordinary room temperature air passed through the warm oil becomes itself warmer and thus will take water vapor from the oil. This has been demonstrated to the writer's satisfaction by placing an iron lid over the pot; the warm moist air coming in contact with this cool lid deposits the moisture upon the inner surface where it drips back into the oil. A trough placed under the points of drip has been used to lead the water into an outside vessel, where the quantity of water in the oil was measured. When a known quantity of water was added to bone-dry oil and the oil then treated the amount of water collected checked closely with that previously added.

The writer trusts that if others are impressed with the enormity of the operation, as he first was, this paper may be of some service to them.

Alternator Troubles.

By A. E. Buchenberg.

PRACTICALLY all electrical apparatus manufactured at the present time is "standardized"; that is, each individual piece of apparatus of a particular type or class conforms to certain standard specifications concerning voltage, speed, frequency, number of phases, output, etc. Upon these specifications are based the maker's guarantees covering the capacity, heating, regulation and efficiency, under certain definite and fixed conditions of operation. Slight inaccuracies in machining and assembling, a possible variation in the quality of the materials used, or an accidental and unnoticed injury to the coil insulating material, all necessitate complete, accurate and thorough shop tests of each individual machine. These regular and standard tests consist of saturation, short-circuit, load and insulation breakdown tests, and in their several relations afford complete and accurate data on the service operation of any machine under normal conditions. Any change from the specified operating conditions will entail a variation in the electrical and mechanical interactions, and may in some cases cause a great deviation from the guaranteed operating characteristics of the machine, and unsatisfactory operation. The accompanying diagram has been worked out as affording a possible aid to the central station man in a careful and systematic search for the cause of some of the more common troubles encountered in the operation of alternators; while being in no way complete it embraces the principal causes as found in the writer's experience among the smaller installations.

Practically all alternator troubles whose causes are not obvious from an outward examination of the machine may be roughly subdivided into excessive heating, poor voltage regulation and inability to carry rated load. Since the maximum available output of an alternator is determined by a safe temperature rise, the latter trouble may be included in the discussion of heating.

HEATING.

The usual form of the manufacturers' full-load heating guarantee on an alternator is as follows:

"This machine will operate for —— consecutive hours at —— volts and —— amperes per terminal, with a power factor of —— per cent, and the rise of temperature in no part will exceed —— degrees Centigrade. With the same voltage and amperes per terminal, but with a power factor of —— per cent, this machine will operate —— consecutive hours with a rise in temperature in no part exceeding —— degrees Centigrade. All temperatures to be measured by thermometer under American Institute standards."

It is important to note that heating guarantees specify the difference between machine and room temperatures, and not the actual temperature of the alternator. Also that all temperature readings are referred to the Centrigrade thermometer scale. The American Institute of Electrical Engineers' standard fixes the basic room temperature at 25° C., and that for each degree above or below this value a correction of one-half per cent is to be made in the temperature rise of the machine.

No reliance whatever should be placed on the fact that any part of the machine "feels" hot to the hand, but actual thermometer readings should be taken in every instance of suspected excessive temperature rise. This is best done by placing the bulb of an ordinary Centigrade thermometer (without a case) on the part of the machine whose temperature is to be measured, and covering the exposed portion of the bulb with a small bunch of cotton or waste. Thermometer readings of the rotating parts of the machine must be taken immediately after the machine is shut down, always noting the maximum temperature reached. Bearing temperatures should also be taken at this time by placing the bulb of the thermometer directly against the shaft journals.

One of the possible causes of excessive temperature rise in the laminated armature iron is the operation of the machine above its rated voltage. Assuming the speed correct this necessitates an increased magnetic flux density in the armature iron with a consequent higher hysteresis loss and temperature. Alternator voltage above normal may be due to an attempt to compensate for excessive line drop, or the switchboard voltmeter may read low from any of a variety of causes such as a bent needle, incandescent lamps connected across the secondary of the voltmeter transformer, etc.

High temperatures in the armature iron may also be occasioned by operating the alternator below its rated speed. Decreased speed necessitates an increase of flux density in the armature in order to maintain a given machine voltage, and as stated above this increases the energy loss in the iron. The resultant temperature is all the higher on account of the less effective ventilation at the lower speed. Operation below rated speed may in the case of belted machines be due to an incorrect ratio of driving and driven pulley diameters, overload on the engine, a poor or improperly adjusted governor may allow an excessive drop in engine speed from no load to full load, or the belt slippage may be great. In the case of engine or water wheel type alternators, low speed may be due to poor no-load to full-load speed regulation, or to an overloaded engine or water wheel.

It will be noted in the general form of heating guarantees given above that the inductance of the load is a determining factor. The usual heating guarantee at 100 per cent power factor, or non-inductive load, is a rise of temperature not to exceed 40° C. for ten hours' continuous operation at normal voltage and full-load amperes per phase. This ideal load condition is never attained in commercial service without the use of special devices, and the actual load power factor will vary from approximately 95 per cent for straight incandescent lighting service, to as low as 40 per cent with series arc light transformers or regulators partly loaded and improperly adjusted. The actual temperature rise under service conditions will, on account of the increased leakage flux and the increased field excitation required to overcome the back action of the lagging armature current, always be higher than that for 100 per cent power factor, the amount of increase depending upon the electrical characteristics of the machine and the load power factor.

A high temperature rise in the armature iron may also be caused by an excessive overload on the machine by reason of incorrect voltmeter, ammeter or wattmeter indications.

ARMATURE COILS.

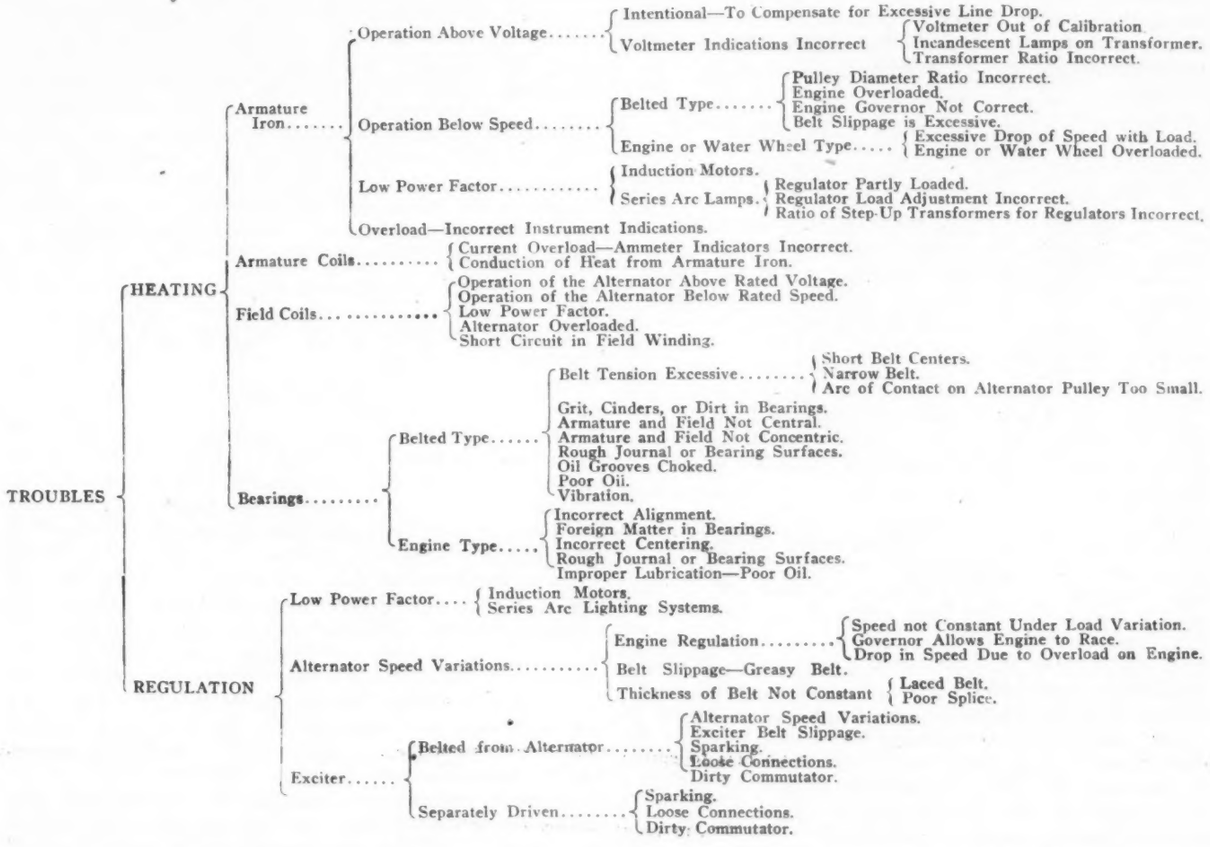
Excessive temperature rise in the armature coils may be due to a heavy ampere overload on the machine, the ammeter out of calibration and reading low, or the conduction of heat from the armature iron which has reached a high temperature from one or more of the causes enumerated above. It can always be assumed that armature coils in service are not defective in insulation between turns, as an internal breakdown is invariably followed at once by the complete destruction of the coil due to the intense heating of the short-circuited turns.

FIELD COILS.

A field coil temperature rise higher than that guaranteed may be due to an increase of exciting current required to maintain the alternator voltage above its rated value, or to maintain normal voltage with the alternator operating below rated speed on low power factor loads, or under heavy overloads. Another possible cause for excessive heating of field coils is an internal short-circuiting of a portion of the field winding, with a consequent increase of exciting current required to compensate for the now smaller number of effective field turns. The failure of one or more field coils from an internal short-circuit may be a very slow process, and in the first stages can only be located by comparative resistance measurements of the several coils. To guard against any danger of an internal breakdown of the field coils it is always best, where special field discharge switches are not in use, to turn in all the resistance of both rheostats before opening the alternator field switch.

BEARINGS.

Heating of bearings in the case of belted machines may be due to one or more of the following causes. Short belt centers or a belt too narrow for the work, may necessitate excessive tension. The arc of belt contact on the alternator pulley may be too small on account of a large diameter of driving pulley in conjunction with short belt centers. Grit, cinders or dirt may have been left in the bearings or oil cellars when the machine was erected, or may have been carried in by a draught from the boiler room or low open windows. If the machine is not assembled in such a manner as to allow the field to come central with the armature, and with a small allowance for end play each way from the central position, all the magnetic pull tending to center the field is concentrated on one end of a bearing sleeve and a shoulder of the shaft. The armature and field may not be correctly adjusted to give an equal air-gap around the entire circumference, and a severe unbalanced magnetic pull is the result. The journal or bearing surfaces may be rough, or the oil grooves in the bearing sleeves clogged with lint and dirt so that the oil is not distributed over the entire bearing surface. The oil may be too light or of a poor quality.



Excessive vibration may exist due to a poor foundation. In the case of engine-type alternators improper shaft alignment may be the cause of the trouble.

REGULATION.

The usual form of regulation guarantee is as follows for full-load conditions:

"At normal voltage the full-load amperes per terminal at —— per cent power factor may be thrown off, and the voltage will not rise more than —— per cent under conditions of constant speed and field excitation. With the same amperes per terminal and —— per cent power factor the voltage will not rise more than —— per cent."

It should be noted in the above that constant speed and field excitation are specified, and that the inductance of the load is again a determining factor. The regulation of an alternator is usually based on full load at unity power factor, and under commercial load conditions will never be so good without the use of synchronous motors or other methods of compensation for inductance. The amount of impairment of regulation by an inductive load will depend upon the electrical characteristics of the machine and the power factor of the load. Since a high

power factor is conducive to good regulation, special efforts should be made to connect the rated number of series arc lamps to each regulator, and where this is not possible to correctly make all adjustments and connections to obtain the highest possible power factor under the conditions.

Variations of voltage may be caused by poor engine regulation due to a defective governor, overload or belt slippage. Periodic variations of voltage are often caused by a laced belt or the increased thickness of a poor splice in an endless belt.

Improper exciter operation affects the voltage of the alternator through a variation of the exciting current, and may be caused by a dirty commutator, sparking or loose connections.

The customary liberal design, and the relatively small effect of some reactions upon the satisfactory operation of a machine make small deviations from the normal operating conditions not at all serious. But since the best and most efficient operation is obtained under the specified conditions it is obvious that every effort should be made to meet them.

What Constitutes Invention.

By John E. Brady.

To be patentable an invention must, under the statutes relating to patents, be of a new and useful art, a machine, a manufacture or composition of matter, or an improvement thereon, or a new and original design. If an alleged invention does not fall within one of these statutory classes its originator is not entitled to a patent upon it. In addition to belonging to one of the classes mentioned the discovery must disclose invention, novelty and utility and the Patent Act provides that the subject matter of the patent must not have been in public use or on sale for more than two years prior to the time the patent is applied for. Further, there must have been no abandonment of the invention or no patent is issuable.

Undoubtedly the most essential element of the right to obtain a patent upon a creation or discovery is that of "invention." Invention is synonymous with "discovery" as that word is used in the Constitution and in the patent laws. The term "invention" is variously defined in the decisions as the work of the head as distinguished from that of the hands, the intuitive faculty of the mind put forth in search of new results, or as the indication of genius and the production of a new idea. Such definitions are necessarily vague, but the element of invention which must appear in an idea to entitle its originator to a patent is invention as distinguished from mere mechanical skill. One test in determining the right to a patent is found in the question "Is the idea one which, in view of the prior condition of the art, would readily suggest itself to the skilled mechanic?" If the answer is yes, then the idea cannot be claimed to be the result of the exercise of any inventive faculty and it is not patentable.

In the history of most of the arts, the first invention is of a striking and undeniable character, for example, that of the telephone, and the earlier improvements likewise usually display an unmistakable power of invention. But, as the art develops, it becomes difficult to distinguish between improvements that involve patentable invention and those that are the result of the exercise of ordinary mechanical knowledge and skill. The distinction is often close and can best be illustrated by reference to the particular cases in which the question has been passed upon. In Chase Electric Const. Company vs. Columbia Const. Company, 143 Fed. 143, it was held that an electric sign intended for advertising uses in connection with theatres principally, so constructed that the wires were concealed from view and that the letters could be removed and replaced without difficulty or expense, disclosed invention and was patentable. Prior to the granting of this patent the wires of such signs were exposed and considerable trouble attended changing the letters. And an armature core built in sections of laminæ, with separators of thin radial metal strips in direct contact with the laminæ, so arranged that complete ventilation was provided between the sections, was held to be the result of meritorious invention. General Electric Company vs. National Company, 145 Fed. Rep. 193. A cluster of electric lamps constructed so that the electricity, instead of being conveyed to each lamp by means of wires was conducted through the medium of two metallic plates insulated from each other, has been held to show sufficient superiority over ordinary mechanical skill to constitute patentable invention. Benjamin Electric Manufacturing Company vs. Dale Company, 141 Fed. Rep. 989. But the United States Circuit Court was unable to find invention in a reflector for incandescent lamps, the court declaring that the invention claimed was more formidable in words than in substance or in complexity of construction. Mygatt vs. McArthur, 143 Fed. Rep. 348. And there was held to be nothing patentable in the device for securing pole-pieces to revolving field magnet structures, the invention being claimed to be in the adoption of the dovetail and key method to the fastening of the pole-pieces to the yoke. The problem was purely a mechanical one. The selection of this well-known method did not require the exercise of inventive skill and no more difficulty attended its adoption than usually follows its employment in numerous devices of the mechanic arts. When conditions are known its adoption usually may safely be entrusted to the skilled mechanic. General Electric Company vs. Pullock Electrical Manufacturing Company, 146 Fed. Rep. 551.

Repair Shop Suggestions.

By A. B. Weeks.

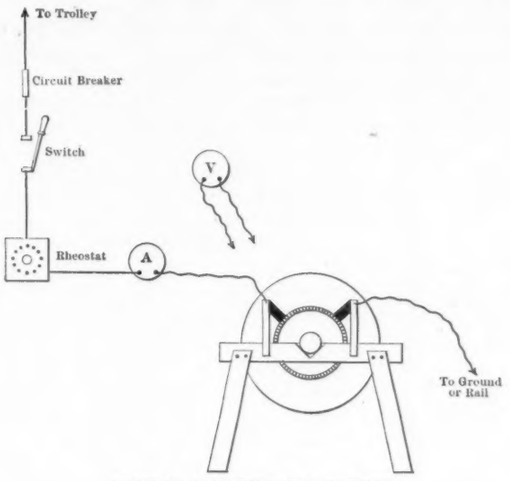
Among small electric roads there often exists a method of carrying on armature repairs which can well be improved upon. For example, in a shop having only a magneto or lamps for making tests, the true condition of the insulation of an armature cannot be known; and chances are therefore taken in making repairs. Often an armature is patched up which has been severely scorched, even for a second time, when its leads are scarcely able to hold the brittle insulation. There is no room for increased insulation of tape, and sometimes one discovers that not even paper or duck has been inserted alternately between the wires. In a case like this, insulating varnish would be of some assistance; but the question is, does it pay? Is a car with such an armature not in the barn more than any other, and is not the fuse or car breaker continually popping, with occasional running on some other car's time? At the head of the armature there may have been a flash from some cause, laying the insulation bare on many coils; or perhaps severely scorching one or more coils. With no other testing device other than already referred to, what chances has a winder of knowing definitely what he is encountering?

Rather than attempt, under these conditions, to merely reinsulate and reconnect, it is better to remove the questionable coils, as it will prove more economical in the end. If one could be sure the armature would stand for long, there would be more excuse for the easier method of repairing; but since it is at best only trifling with an important matter, one had better be on the safe side. There are times, it is true, when an armature gets little knocks which can be fixed up in the old way without trouble; but the old armature with brittle insulation is another matter.

Even if from fifty to several hundred dollars were invested in a testing outfit, many managers would hesitate to entrust the apparatus to a man who does not know reasonably well how to manipulate it; the small road needs just such a set as much as the large one, yet it seldom has it. They will rewind an armature and thrust it into a car for use with but a single lamp test for ground; yet a good set of portable testing instruments consisting of an ammeter and a double-scale voltmeter can be had which is accurate and not expensive. The following idea for tests is not new and has been written up in the past and

used for years; yet it is well worth repeating for the benefit of those who have not tried it:

Set up a pair of wooden horses and cut a V in each; place the armature in these grooves, and rig up two brush holders



TESTING ARMATURE FOR DEFECTS.

for same relative position occupied in the motor. Close circuit-breaker, then switch; and put on 30 amperes with rheostat. Next, connect the voltmeter to the second indicating scale, which stands first at open, then 600, next 10, according as moved. This switch was recently brought out, and is invaluable, from the fact that with its use it is next to impossible to burn out a coil. It makes a meter almost "fool-proof." When the armature has warmed up a few moments, test from bar to bar with the free ends of voltmeter leads. Should the majority of the readings indicate 2 volts, for example, it shows the standard reading between the armature sections; anything less indicates something wrong, according to the degree of deflection. If zero, there is a short, which can be traced either to the commutator or the armature, by disconnecting and testing each separately. If the leads have been newly soldered in, the chances are that solder bridges the bars and has caused the trouble. Scrape front and back. Troubles in the interior of commutator shells are not so frequent as formerly. If the commutator shows free, then the source of the difficulty is known at once without further testing. Take out the questionable coil. Dampness or other trouble may also have grounded the coil. An insulation test first would have determined the ground, but not a short. Use the high scale for the ground test. Place one wire anywhere on the commutator or brush holder, and the other apply to the ground connection; 200 volts or under shows weak insulation. Use your own judgment for further locating the fault. Usually this is not difficult to locate, as exterior conditions point to the source of trouble. The whole armature may be affected, or a single coil or section.

More elaborate testing outfits are made, of course, but this article is for the man who would be more than content with the apparatus described above.

The writer, from observation, is convinced that to get the best results, a black baking oil-proof insulating varnish should be finally used on a finished street railway armature. Some master mechanics argue that with a good oil-proof compound on the coil when made, there is no need of a high grade oil-proof insulating varnish on the finished armature. This is in a measure true; but where the insulation of one coil has been weakened by undue hammering, or the extra insulation at the ends of the armature slots has accidentally cut through, or the insulating paper shows pin-holes, this make of varnish is most desirable. Air drying varnish soaked into the parts reinsulates until its life is spent; then trouble will develop. This practice is, however, followed by some of the best interurban roads. To be strong, electrically, a varnish must also be strong mechanically.

Some armature winders in adopting the method of cutting down expenses by reducing the number of sets of armature coils bought per month, are forced to do so by a management which does not fully appreciate the real expense engendered; on the other hand, however, a waste of material in the department may have brought about this result. For example, a certain road had in use asbestos field coils, which sometimes had a burnt out appearance. These were scraped, but a new foreman on looking them over found they were not burnt out; he proceeded to reinsulate the outside with tape and varnish and put them in service again. These are not uncommon conditions, nor are such errors in judgment confined to the electric railway system.

Armature coils should be kept in a dry place, and not left where rubbish and gears can fall on them, or any moisture creep in. Commutators should be kept in the store room and handled with care. Not every helper realizes what a delicate thing a commutator is. I would not recommend stacking several commutators one on another, for if overturned, considerable damage may result. Pinions, gears and commutators would cause a serious mix-up if stacked near together in the store room. Avoid armature or field coils whose varnish is wet. Some will tell you wet varnish will stand as high a puncture test as dry. You will find others who can tell you from unfortunate experience that this is not entirely true. Some will also claim that the green on the wire will cause no damage; others can show coils burnt out from this cause.

Some winders find as much mystery in insulating varnishes as in the feats of a magician. If they have bought a certain kind for a dozen years they will swear by it and refuse to try another for fear of ruining their motors. Even if others are paying less and getting quite as good results, nothing would induce them to change. Don't be above testing new materials; and when results warrant it, don't refuse to be convinced.

Installing Feeder Conduits in Fireproof Buildings.

BY T. W. POPPE.

When running main line conduits in which the feeders will be drawn, care should be taken to have all joints well made so the wire will have a clear raceway. Should burrs be allowed to remain in the conduits when screwed together they will retard the insertion of the wire and perhaps damage the insulation. Particular care should be taken with feeders in this respect as insulation so damaged is very apt to result in a heavy ground. The resultant heat will melt the insulating compound and the wire which will necessarily have to be withdrawn from the conduit will adhere to it at this point and trouble will be

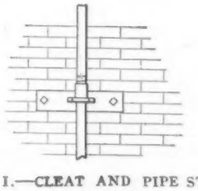


FIG. 1.—CLEAT AND PIPE STRAP IN PLACE.

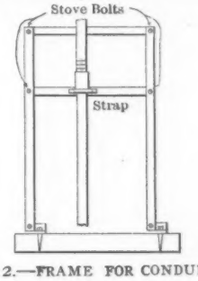


FIG. 2.—FRAME FOR CONDUITS.

experienced. It will also mean the loss of the wire damaged and vexatious delays.

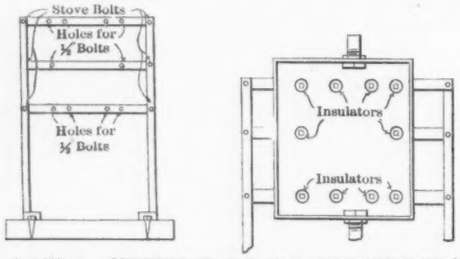
Upright lines of conduit should be fastened in such a manner that the panel box will not be called upon to support their weight. Each length of conduit put in should be fastened separately so that the one below will not bear any of the weight of the one above. This can be done by drilling two holes in the brick wall, if the conduit runs up beside a brick wall, in-

serting lag screw anchors and fastening a piece of 2 by 4-in. joist, as long as necessary, against the wall, using lag screws to secure it. This joist, known as a cleat, should be so placed that the bottom of the coupling on the pipe or conduit will be level with the middle of the cleat. Pipe straps can then be placed upon the conduit close up against the bottom of the coupling. Two-inch screw should be used to fasten the strap to the cleat. Pipe straps so placed will carry separately the weight of each length of conduit. This arrangement is shown in Fig. 1.

Should the conduit be run in a fire brick partition it can be fastened by placing a piece of joist upon the rough floor and erecting on it a frame of angle iron so made as to have the center of the top horizontal piece of iron even with the bottom of the coupling. Holes can be drilled through the iron and a pipe strap bolted to it. The weight of each length is thus sustained by the angle iron frame. Several lines of conduit can be fastened to a frame of this description, which is shown in Fig. 2.

A workman should endeavor to have each length of conduit fastened separately so that were a portion of the line removed the part above would remain in position without too great a strain being placed on the woodwork of the panel box or the thread of any elbow which might be above it.

Judgment must be used when installing the conduits. A



FIGS. 3 AND 4.—SHOWING FRAME AND INSULATORS IN PLACE.

pull box readily accessible at all times should be conveniently placed on all lines over one hundred feet long in which four elbows have been used. Elbows and bends should be avoided if possible. When running vertical lines, should the conduits be perfectly straight from bottom to top and not be connected to any horizontal line, it is proper to put in two elbows even if not necessary otherwise. The horizontal lines will thus support the cable suspended in the conduit and in the absence of a horizontal line the friction caused by the cable pulling around the curves in the two elbows will tend to resist the downward pull due to the weight of the suspending cable. This takes all the strain off the lugs and fastenings of the panelboard.

Should the construction of the building not allow of two elbows being placed in a vertical line of conduit some means must be taken to secure the cable and prevent the strain due to the weight of the cable upon the lugs and panel board fastenings. The arrangement as shown in Fig. 5 has been used with success. A pull box is placed in the wall and the conduit run to and from it. The pull box is made of oak lined with sheet iron and fastened to a frame of angle iron, as shown in Fig. 3.

In the three horizontal pieces ten 5/8-in. holes are drilled as shown, and ½-in. bolts 3 in. long and threaded their entire length are placed through the holes. Holes to correspond are drilled in the back of the pull box and the pull box fastened to the frame by screwing nuts on the bolts firmly against the sheet iron lining of the box. Insulators known as circuit-breaking insulators are placed over the projecting part of the bolts and firmly secured by screwing nuts on the bolts, placing a leaden washer between the nut and the insulator.

This, when finished, gives an arrangement similar to that in Fig. 4. When the cables are drawn into the conduit they are arranged as shown in Fig. 5. This holds the cable firmly in place. The plan, as shown, was used on a two-wire system, but three wires can be used by installing more insulators in the box.

When the box is placed in position and the conduit finished, the box, conduit and frame should be firmly cemented in the wall. When the cable is drawn in and arranged a neat wood trim made to match the surrounding wood work can be placed on the pull box so that the box is always accessible.

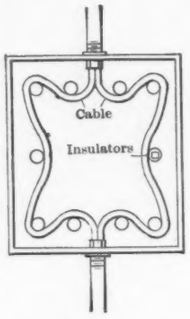


FIG. 5.—CABLES IN PULL BOX.

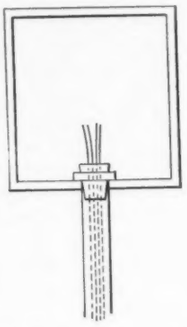


FIG. 6.—WEDGED CABLES.

The above scheme is appliable where mains are extended to a height of 80 ft. or more and should the table be large the height of the pull box can be arranged to suit the size and weight of the cable and as many pull boxes as necessary to properly secure the cable can be put in the line. The box can be made to accommodate as many cables as desired by enlarging the box and placing heavier band or angle iron in the rear of the box.

In short lines having no elbows and in slightly longer lines having two elbows a wooden wedge can be made by boring holes slightly smaller than the diameter of the cable parallel with the grain in a piece of wood of a larger size than the conduit. The wood is then tapered to a size slightly smaller than the inside diameter of the conduit. The wood is then split through the holes bored, placed in the conduit and ham-

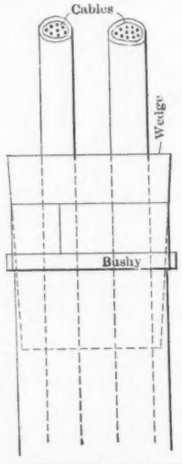


FIG. 7.—DETAILS OF WEDGE.

mered till firmly wedged. The holes being smaller than the cable and the wedge being tapered to a size larger than the conduit the wedge will press firmly together, holding the cable securely and any extra weight on the cable will tend to tighten the wedge. Figs. 6 and 7 show this arrangement.

Fuels for Steam Making.

By R. T. STROHM.

Fuels, as employed in the generation of steam, are of three classes, namely, solid, liquid and gaseous. Of these, the solid fuels are by far the most abundant and most generally used, the liquid and the gaseous fuels finding application mainly in or near those localities in which they naturally occur.

The heating power of a fuel is due to the fact that it contains certain elements which will unite with oxygen in the well-known process of combustion, or burning, forming gaseous products. There are, however, other elements in fuels which are not converted into gases during combustion, and these elements are known as non-combustible.

The chief combustible element in fuels is carbon, which, when burned, forms a gas known as carbon dioxide. Next in importance is hydrogen, which, in combination with oxygen, forms water. In some gaseous fuels, hydrogen occurs free, but in the solid and liquid fuels it is more commonly combined with a portion of the carbon in the shape of compounds known as hydrocarbons. Sulphur is a combustible element that is found in some fuels; but, although it possesses some heating value, it is regarded as an undesirable constituent. For, when there is iron in the fuel, the sulphur combines with it, the result being the formation of clinkers that clog the grates and adhere to the furnace walls. Furthermore, in the presence of moisture the gases formed from burning sulphur have a corrosive effect upon the iron of the tubes or shell of the boiler.

The non-combustible substances found in fuels may be either solid, liquid, or gaseous. In the solid form, ash is the main incombustible constituent, and it includes such mineral substances as lime, silica, alumina and iron. The gas nitrogen is contained to some extent in all fuels, and since it cannot be burned it really detracts from the heating value of the fuel by absorbing a part of the heat generated during combustion in the furnace. Oxygen is also found in fuels, being in combination with hydrogen in the form of moisture. Water being an incombustible compound, the moisture in a fuel also serves to carry away heat that could otherwise be used to better advantage. These various non-combustible substances may be properly regarded as impurities. Thus, for every one per cent. of ash or of moisture, the handling of a ton of fuel involves the handling of 20 pounds of weight from which there is no useful return. Impurities are doubly undesirable, therefore, since they decrease the effective heating value, and at the same time add to the cost of labor.

The composition of a fuel is expressed by an analysis, which is a statement of the constituents. The analysis may be either proximate or ultimate. In a proximate analysis there is no attempt made to separate the fuel into its elementary parts. Instead, it is examined with the purpose of determining the proportions of moisture, ash, volatile matter and fixed carbon. The ultimate analysis resolves these several parts into their elements, and expresses the several percentages of carbon, hydrogen, sulphur, oxygen, nitrogen and ash in the fuel.

When a fresh charge of coal is thrown into a furnace, the first action is the driving off or distillation of the gases contained in the fresh fuel. These gases form what is known as the volatile matter, and consist largely of hydrocarbons. There remains, after this process, a solid product consisting of carbon and the incombustible ash. The percentage of this residue that is carbon is known as the fixed carbon in the fuel. The relative proportions of volatile matter and fixed carbon in a coal determine its classification. Thus, it has become customary to divide all coals into five great classes, known as anthracite, semi-anthracite, semi-bituminous, bituminous and lignite. These coals are classified according to their hardness or compactness, as well as according to the amounts of fixed carbon they contain. Anthracite, or hard coal, contains from 93 to 97 per cent. of fixed carbon, and from 3 to 7 per cent of volatile matter; semi-anthracite from 87.5 to 93 per cent. of fixed carbon; semi-bituminous, from 75 to 87.5 per cent. of fixed carbon; and bituminous from 50 to 75 per cent. of fixed carbon. Lignite contains less than 50 per cent. of fixed carbon.

Knowing the percentages of carbon and hydrogen contained in a coal, it is a simple matter to calculate the heat value per pound of that coal. The complete combustion of a pound of carbon yields 14,600 heat units, and of a pound of hydrogen, 62,000 heat units. Consequently, by multiplying the percentage of carbon by 14,600, and the percentage of hydrogen minus ⅛ the oxygen by 62,000, and then adding the two products, the heating value of a pound of the coal is obtained.

Since hydrogen contains four and one-quarter times the heat-producing power of carbon, weight for weight, it might be concluded that a coal rich in hydrogen—that is, a coal containing a larger percentage of volatile hydrocarbons—should be of far greater value than a coal rich in fixed carbon and low in volatile matter.

Such a conclusion, however, would be erroneous, since it is not borne out by the results of a large number of trials of different fuels under varying conditions. In other words, the coal whose calculated heat value is highest is not necessarily the best to use as a steam fuel. This is due to the fact that under ordinary conditions of operation, it is not possible to obtain and utilize the heat represented by the large percentage of volatile matter.

Coal used for steam-making purposes should be of such a grade as to take fire easily and burn rapidly, with a steady flame. In order to kindle readily, it is necessary that the fuel shall contain a small amount of volatile matter. Another point to be desired in a steam coal is a low percentage of ash, as this will reduce the expense of handling refuse. Sulphur should not be present in any great proportion, as it aids clinkering and corrodes the boiler surfaces.

To conform to such requirements as these the choice of good steam coals narrows down to anthracite, semi-anthracite and semi-bituminous; that is, to those coals in which there is from 75 to 90 per cent of fixed carbon, and from 25 to 10 per cent of volatile matter in samples dry and free from ash. Of the three grades mentioned the semi-anthracite and semi-bituminous are to be preferred to the anthracite, since they ignite more readily and burn more freely.

When a charge of coal high in volatile constituents is fed into a furnace there is a sudden formation of a large volume of combustible gases, due to the heating of the charge. To have perfect combustion a correspondingly large volume of air must be admitted at the same time to unite with the hydrocarbons. If sufficient air is not supplied there will be a loss due to the escape of unburned combustible. On the other hand, if the supply of air is continued beyond the time when the volatile matter is driven off and burned, there will be loss due to the excess of air over and above that required to furnish oxygen for the combustion of the fixed carbon. It is an exceedingly difficult matter to vary the air supply according to the instant demands for oxygen in the furnace, so it is customary to furnish a regular supply about twice as great as that theoretically needed to give perfect combustion of the fuel.

A fuel that is high in volatile matter, as, for example, a bituminous coal from the western fields, burns with a long, smoky flame. If, as is commonly the case, these flames strike against comparatively cold tubes or plates before combustion is complete, the gases are chilled, combustion is checked and soot is deposited on the boiler surfaces and in the fire tubes. The escape of unburned gases is, of course, a direct loss.

The two preceding paragraphs show why a coal containing much volatile matter, and therefore possessing a high theoretical heat value, may prove less effective than another grade of fuel of smaller calculated heat value. From the results of a large number of tests it has been found that the highest evaporative results per pound of fuel have been obtained by the use of semi-bituminous coal. It kindles easily, burns without smoke, has a short flame and may, therefore, be used in firebox, return

tubular, or water-tube boilers with little loss due to chilled gases. As a rule it contains small percentages of ash, moisture and sulphur. As a consequence semi-bituminous coals are regarded as among the very best steam coals in the world. Using the semi-bituminous variety as a standard of comparison, the relative values of the various other grades of coal are as given in Table I.

Table I.

Coal.	Heating values per pound.		Relative values Semi-bituminous = 100.	
	Combustible.	Coal.	Combustible.	Coal.
Anthracite	14,700	12,600	93	89
Semi-anthracite	15,100	13,000	94	91
Semi-bituminous ...	15,750	14,200	100	100
Bituminous (East.).	15,000	13,500	95	95
Bituminous (West.)	14,200	11,000	90	77
Lignite	12,200	7,900	77	56

The selection of a grade of coal to be used for steam generation will involve the careful consideration of several factors that affect the result. Of course, the ultimate aim is to obtain as great a number of available heat units as possible, at the least cost. But where so many conditions govern the final decision, this is by no means an easy matter.

In order to come to a satisfactory conclusion regarding the best fuel to select, it is necessary to know the following: The cost per ton of the several kinds of fuel that are available; the heat value per pound of each of the fuels; the percentage of the heat value per pound which may be considered as available for heating purposes in the boiler; the highest rate of evaporation of the boiler or boilers with different fuels; the cost of handling the different fuels, as well as the cost of handling their refuse; and the freedom from smoke production of the several kinds when burned in the furnaces considered.

Confining the present discussion to steam coals, it may be stated that the price per ton of any given grade is a variable quantity, depending upon its abundance, the demand for that particular grade and the distance it must be transported. Freight rates, the cost of storage and the dealer's profits will increase the cost per ton. Because of freight rates, therefore, it will usually be found advisable to use that grade of coal which is mined in closest proximity to the power plant, the boilers and furnaces being adapted to the use of that particular fuel.

The heat value of coal, per pound, is not a safe guide in the selection of a boiler fuel, for the reason that the boiler setting or the grates may not be at all adapted to the economical use of certain grades. Thus, if bituminous coal is to be burned, the furnace must be arranged for a gaseous, long-flaming coal, whereas with anthracite the flame is very short, and the fire may be kept in closer proximity to the tubes or shell of the boiler without danger of cooling the hot gases too quickly and thus producing smoke.

The same boiler, with different fuels, will give different evaporative efficiencies. That is, the available heat in any given case depends upon both the boiler and the fuel. By multiplying the heating value of each available fuel by the efficiency of the boiler when using each grade, the heat utilized in each case may be determined. The one that permits the greatest amount of heat to be usefully applied, at the least cost, will be found the most economical.

All this presupposes unchanged conditions in the way of furnace, boiler setting and draft. But such a method of procedure is not fair to some grades of fuel. There are certain conditions as to grate surface, furnace arrangement and draft, under which each coal may be burned with highest efficiency, and in selecting a permanent fuel for a plant all these factors should be considered. If it is desired merely to tide over a period during which a strike has temporarily stopped the supply of the customary coal, and it is not thought advisable to change the boiler settings, then the methods outlined in the next preceding paragraph may be employed.

If a plant requires a certain output of power and additional boilers cannot be installed, owing to lack of room or other reasons, then the selection of the coal will be simply a grade having a high enough evaporative power, with the given boilers, to furnish sufficient steam to the engines, regardless of whether it is the cheapest or the dearest.

Again, the draft obtainable in a plant may influence the selection of a fuel. If a chimney is designed for certain conditions, it is possible that an attempt to change both the grade and the kind of coal would result in trouble with the draft. Consequently, the maximum draft pressure obtainable with the existing chimney must be known before the wisest selection of a fuel can be made.

The percentage of ash in a coal is an important factor in determining its desirability as a regular fuel. Generally speaking, the cheaper the grade of coal used, the greater the percentage of ash and clinker, and the greater the difficulty in keeping a clean fire. With stationary grates, the use of the slice bar at frequent intervals causes wear and tear on the grates, and results in shaking a larger proportion of the fuel into the ash pit, where it forms a direct loss.

The handling of the ashes also becomes an important item, especially in cities where it is necessary to cart them away or otherwise remove them from the vicinity of the plant. All other things being equal, therefore, the coal that contains the least percentage of ash will be found the most economical.

In most of the larger cities there are ordinances prohibiting smoke from power plants. Where such laws exist, the selection of coal narrows down to those kinds which can be burned without smoke, usually the anthracite varieties.

Pumping Coal from the Susquehanna River at Harrisburg, Pa.

On the bottom of the Susquehanna River, all the way from Wilkesbarre to below Steelton, there are large deposits of anthracite coal. The small is usually small in size, pea and buckwheat with occasional mixtures of chestnut, and has been washed down the river in time of freshets from the coal banks and culm piles along the river from Nanticoke and Millersburg and from Shamokin Creek below Sunbury. The largest deposits are found in the neighborhood of Plymouth and Northumberland where the north and west branches of the Susquehanna River come together. At Clarks Ferry dam, 16 miles above Harrisburg, about 25,000 tons are pumped from the river annually; and at Steelton, which is a short distance below Harrisburg, there is also a large deposit, since the river at this point is both deep and wide.

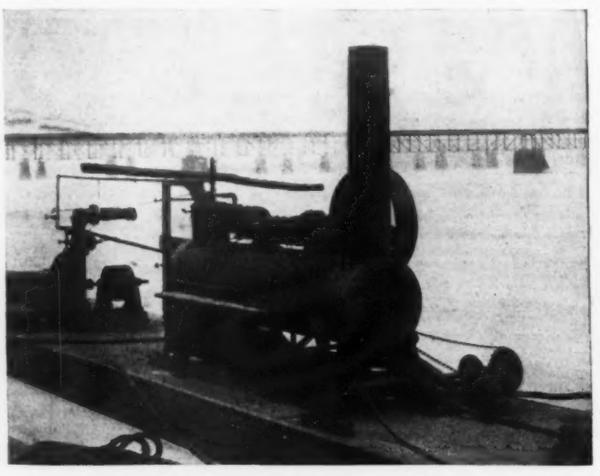


FIG. I.—COAL PUMPING EQUIPMENT.

The coal forms with sand in bars in all eddies, still water beds, back of bridge piers, etc. At Harrisburg, the supply is found chiefly back of the many bridge piers in the river at that place. The size of the coal at Steelton and Harrisburg is principally No. 4 buckwheat with traces of pea coal. The coal is, for the most part, pure carbon, with very little slate, because the latter, being flat, will not roll along the river bed to any extent. Needless to say, the coal is remarkably clean after its long journey, and its heating value is as great, if not

greater, than the same size of anthracite coal found on sale in the city, and which has been transported by rail. This is because the heating value of coal stored under water, as the former is, does not suffer much loss; whereas coal stored by ordinary methods with access to air loses about one-fifth of its power according to recent experiments made in England for

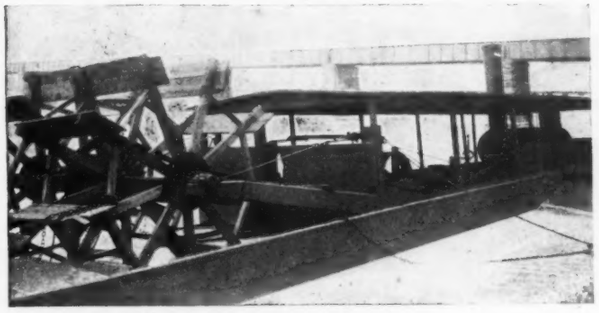


FIG. 2.—STERN WHEEL TOWBOAT.

the purpose of determining this point. At Wilkesbarre and Nanticoke, the river coal sells for $1.25 to $2.50 per ton according to its size, while the price of coal found at Harrisburg is about $1.50 per ton. The coal is taken from the river bottom by dredges and pumps at the various points, chiefly by the latter. The Harrisburg Light, Heat & Power Company has a complete equipment for pumping the coal from the river at Harrisburg, and since this is similar to the others used on the river a description of its operation and also some facts regarding the cost will doubtless be of interest.

The outfit of the company comprises six flats, having a capacity of about 12 tons each; two deck flats and one stern-wheel shallow draft steamboat for towing the flats to the shore when loaded. The entire outfit is shown on the river bank in Fig. 3 where it is moored for the winter. The steamboat, which is shown in Fig. 2 is driven by a 20-hp horizontal engine, the stern wheel being driven by chain and sprocket. The coal pumping outfit is shown mounted on a deck flat in

FIG. 3.—COAL PUMPING OUTFIT ON BANK OF RIVER.

Fig. 1. This consists of a No. 6 sand pump driven by belt from a 12-hp portable engine mounted as shown. The coal pumping process is as follows: The coal and sand bed is located and the pumping outfit anchored over it. The anchor is attached to a drag rope wound around a drum, the latter being connected by slow motion gear to the engine, so that when the dredge is anchored with the full length of the drag rope played out, the drum is wound automatically so as to pull the dredge from one end of the deposit to the other.

The pump is primed in the usual manner before operations are begun. The suction pipe is a 6-in. wire bound hose about 8 ft. long fitted with a flared suction end and hangs over one side of the boat. Sand, water and coal are pumped together and are discharged on an inclined screen, mounted between the dredge and the flat and supported from a pole as shown. The screen has a 3/8-in. square mesh through which all of the water and sand pass out into the river. The sticks and stones are picked out of the coal while it is still on the screen and when the coal is thoroughly clean it is hoed into the flat. There are three men allotted to the outfit besides one man to run the steamboat, and one on shore to take care of the loaded flats as they are towed in.

The coal pumping process begins about March 1, or as soon as the river is free from ice, and ends about the 15th of December. During the season just closed the Harrisburg Light, Heat & Power Company pumped over 9,500 tons of coal and purchased 13,500 tons. The average cost of pumping the coal from the river and delivering it to the boiler room of the power house was 87 cents per ton; while during some months when the supply was plentiful the total cost per ton was a trifle less than 66 cents. The coal can be burned direct in furnaces properly fitted and with sufficient draft; but the lighting company mixes it with bituminous in the proportion of one part of bituminous to 10 parts of anthracite, due to lack of boiler capacity. Bituminous coal in Harrisburg costs $2.65 per ton.

The Regulation of Boiler Feeders—I.

BY CHARLES S. TOWNE.

When an engineer wishes to have an automatic regulator of any kind installed in his plant, it is not uncommon for the owner or the superintendent to conclude that his sole object is to secure an automatic appliance that will save him the trouble of regulating the service, whatever it may be by hand. If this conclusion is correct there is nothing to be ashamed of about it, for the simple reason that at the present time there are many engineers who are sadly overworked, and in some cases this is carried so far that only a man who has a strong constitution can stand it, and even such are injured in a comparatively short time by the strenuous life required.

The fact in the case is that while such appliance is intended to render better service than can be secured by hand regulation, it also saves the engineer much care and some labor, so long as it is in good order. This shows that these regulators operate to the advantage of both owner and engineer, where the latter has personal charge of maintaining a proper water level in the boilers. My attention was called to a case some time ago where the engineer declined to consider the installation of feed-water regulators, because he would have to keep them in repair without corresponding personal benefit, as the fireman had to care for the water level himself. This is not a perfectly proper way to view the matter, because the firemen in many of our modern plants have to do much manual labor in addition to caring for pumps, etc., hence every reasonable effort should be made to lighten their burdens, especially if measures taken to do this will increase the general efficiency of the plant.

The result of my observation along this line is that owners of steam plants are willing to invest in whatever promises to pay a reasonable profit; hence it is right for them to ask if it will pay to install an appliance that will automatically regulate the supply of water to their boilers, and a clear answer should be given.

Under some conditions it will not pay, and these are as follows: If a type of boiler is used that holds a large quantity of water, the water level will not change rapidly because a considerable quantity must be evaporated in order to lower it, say, two inches; and it follows as a natural consequence that a good many gallons must be pumped in to raise it two inches. If only one boiler of this type is used and the engineer is not overworked, he can attend to the water level and get good results without hardship. A high and low-water alarm should be installed in every case, so that warning will be given

when the pump unexpectedly increases its speed enough to flood the boiler and run the risk of wrecking the engine, or decreases it until the upper parts are in danger of being burned for lack of water. It is assumed that the engineer is not required to attend to other duties in addition to caring for his plant.

It will pay to install automatic regulators for boiler feeders in cases where only one boiler is used, provided it holds but a comparatively small amount of water, as the water level changes rapidly in such boilers if the feed water is not very carefully regulated. In some of the water tube boilers now in use the storage capacity is so limited that if the water level is raised to the top of the gauge glass and the pump is then shut down, the water level will fall to the bottom of the glass in three minutes, while the boiler is carrying only a moderate load. Where an engineer has charge of such a boiler and also acts as fireman, his duties are onerous, because he is so closely confined to them.

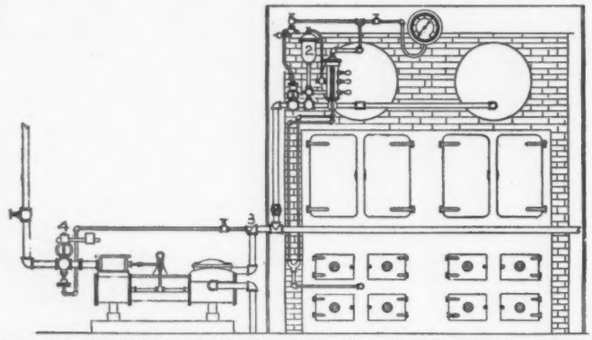


FIG. 1.—AUTOMATIC REGULATOR ATTACHED TO WATER-TUBE BOILER.

Where three or four boilers of any kind are in use, these regulators should form part of the equipment, and for all large plants they cannot fail to prove a paying investment. It is assumed that a good kind of regulator is used and not abused.

Fig. 1 illustrates an automatic regulator attached to a horizontal water-tube boiler. It is set to maintain the water level at the second gauge on the water column, and with this particular kind of regulator the bottom of the chamber, 2, must be 10 in. above the water line. Suppose there is only one gauge of water in the boiler, thus leaving the inlet to the water column opposite the second gauge uncovered so that only steam enters and passes over into the regulator chamber 2 in Fig. 2. The copper float, 3, is heavy enough under these conditions to overbalance the counterweight, 4, and keep the balanced valve, 5, closed, consequently the feed valve, 6, is open as water from the boiler feed pump enters under the disc, as shown. As the water level rises it covers the outlet opposite the second gauge, hence water is forced up into the chamber, 2, causing the float, 3, to rise, because it is lighter than an equal volume of water. This action allows the counterweight, 4, to move downward, opening the balanced valve, 5, which admits steam from the boiler through the pipe, 7. This acts on the piston in the upper part of the feed valve, 6, forcing it to its seat and shutting off the water supply. When it has been shut off long enough to allow the water level to fall less than one inch, the action is reversed and water enters the boiler again.

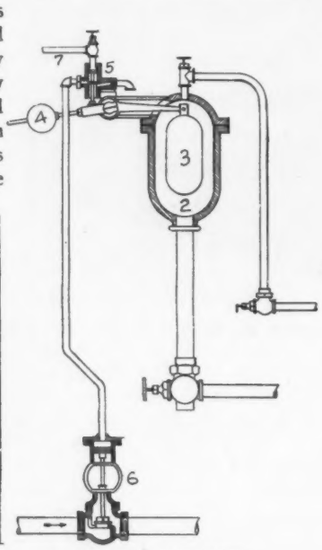


FIG. 2.—REGULATOR.

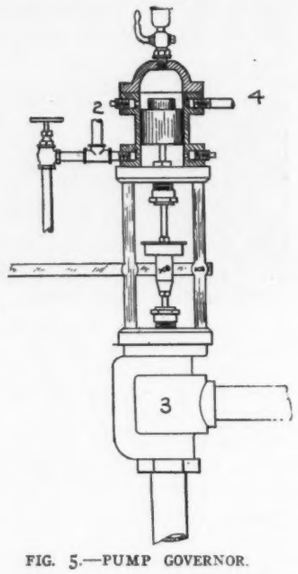


FIG. 5.—PUMP GOVERNOR.

This application of a regulator operates on the feed water valve, thus allowing the pump to run as before for the following reason: If only one boiler is in a plant, it is practicable to shut down the pump when the water level is high enough to warrant it, but in this case the boiler is only one of a battery, as the main feed pipe is continued across its front to supply those beyond it, and one or more of them will sometimes need water when Fig. 1 is shut off, hence the pump must be kept in motion. The time will come, however, when all boilers will be shut off together and this will cause excessive pressure to accumulate in the feed pipe unless means are provided to prevent it. The fireman or water tender cannot be expected to always detect such a combination of circumstances in time to avoid trouble; therefore it must be taken care of automatically, for the steam piston of a direct-acting pump is usually made much larger than the water piston, as otherwise the pump would not run at a high speed when it is required, consequently it can create a very high pressure in the feed pipe.

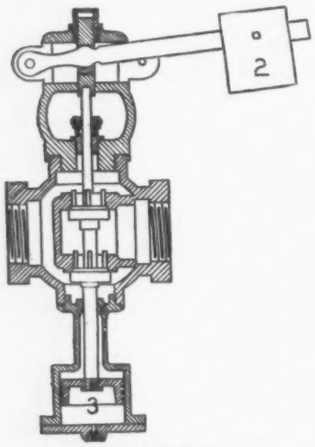


FIG. 3.—BALANCED VALVE.

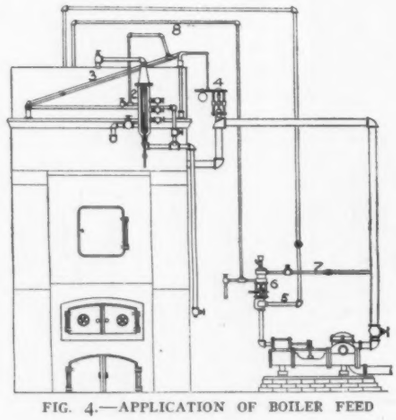


FIG. 4.—APPLICATION OF BOILER FEED REGULATOR

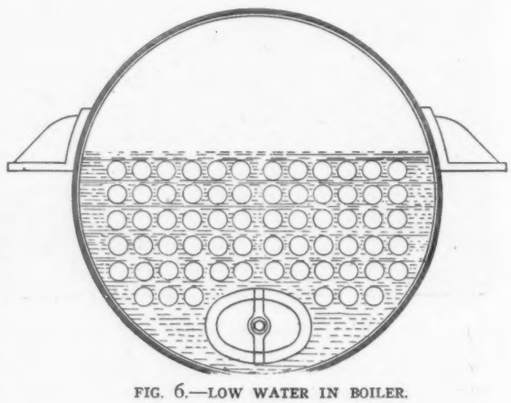


FIG. 6.—LOW WATER IN BOILER.

To overcome this objection a small pipe is connected as shown at 3, Fig. 1, and this communicates with a pump governor, 4, as shown. The operation of this device will be understood by examination of Fig. 3. Suppose that the maximum boiler pressure is 100 pounds and the pump governor is set to operate at 120. So long as pressure in the feed pipe is less than 120 pounds the weight, 2, holds the balanced valve

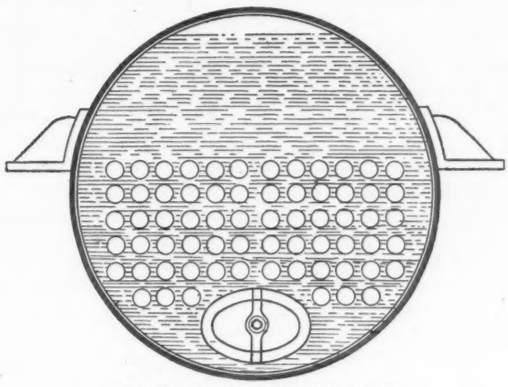


FIG. 7.—HIGH WATER IN BOILER.

open, and as the throttle valve is never closed while the plant is in operation, steam passes freely to the pump. If all of the feed valves are closed, pressure will quickly rise to 120 pounds, and as this is communicated to the piston, 3, by means of the small pipe already mentioned, it forces the valve upward and closes it in direct opposition to the leverage exerted by 2.

Fig. 4 shows the application of another boiler-feed regulator. Assume that there is one gauge of water in the boiler and that the pump is in full operation. A small pipe, 2, is connected into the water column just above the second gauge, in order to conduct steam to the expansion tube, 3, which is thus caused to assume its greatest length, the effect of which is to open the balanced angle valve, 4, and allow water to go into the boiler which in this case is of the vertical water tube type. When the water level is high enough to cover 2, steam is shut off from the expansion tube, 3, causing it to contract and close 4 until the water level falls a trifle, when this action is reversed and water flows into the boiler again.

Steam to operate the pump is taken through the pipe, 5, and the pump governor, 6. When 4 closes, the pressure rises quickly, and is communicated to 6 through the small pipe, 7, the effect of which is to stop the pump until more water is wanted. Steam to assist in the operation of 6 is taken through the small pipe, 8, the operation of which will be understood by examination of Fig. 5. The upper part of this pump governor consists of a cylinder in which there is a piston that controls an angle valve below it. When steam is admitted to this cylinder through the small pipe, 2, it raises the piston shown and opens the valve, 3. Suppose that the governor is set to close at 20 pounds above boiler pressure. When the feed valve closes and this pressure is secured in the feed pipe, it passes through 4 to the upper side of the piston and forces it downward thus closing the valve, 3. An oil cup is provided on top of this regulator to lubricate the cylinder.

This prevents the accumulation of excessive pressure in the feed pipe, and still keeps the pump in operation so long as even one boiler in a battery that is equipped with this device needs water. I have seen a plant containing both horizontal and vertical boilers (which, of course, made the water level in some of them much higher than in others), run without regulators for the boiler feeders; consequently either the high or the low water alarm on one or more of them was nearly always blowing, notwithstanding the fact that the fireman frequently changed the feed valves in efforts to keep the water level where it ought to be in the several boilers. When it is known that the fireman of this plant is required to burn 12 tons of coal per day, under forced draft created by steam jets that must all be regulated by hand to suit various requirements, and that he also must clean his fires without assistance, it will be plain that he leads a strenuous life. It would prove a good investment to equip this plant with boiler feed regulators of an approved pattern, but in many cases such improvements are not introduced until after several firemen have resigned their positions to seek less laborious employment, causing much annoyance to the engineer, and more or less loss to the owners; because a new fireman must learn the details of the plant before he can do his best work, and while he is acquiring this knowledge he is not burning coal to the best possible advantage.

This shows that a boiler feed regulator is practically a necessity where any kind of boiler that holds but little water is in use; but it will pay to install them on tubular boilers where the storage capacity is comparatively large, because an ordinary fireman or a water tender will allow the water level to fall as low as safety will admit, as illustrated in Fig. 6, and while his attention is given to other matters the pump will run fast and fill the boilers until they appear as shown in Fig. 7. The objection to the former is that it is too near the danger line, for if the pump should fail to respond promptly, the upper row of tubes would be burned, unless the boiler is laid off at once. Its advantage is in the large disintegrating surface exposed, which allows steam to rise slowly from the large water surface, and this is an important point in favor of securing dry steam.

The only advantage due to the high-water level shown in Fig. 7 is that if the boiler feed pump should be disabled now there might be time to fix it before the water level would become dangerously low. On the other hand, there is danger of letting it get so high that water will be forced over into the engines, causing an expensive wreck. Even if this does not happen, more or less water will go over with the steam, causing clicking in the cylinders of certain types, and greatly increasing the risk of scoring all of the internal rubbing surfaces, for water that comes over from a boiler usually contains more or less matter that is not wanted in a highly polished cylinder.

Fig. 8 illustrates the application of a regulator to a tubular boiler. The bottom connection of the regulator, 2, is made into the lower-water column connection, which is not always good practice, as these connections should be used solely for the

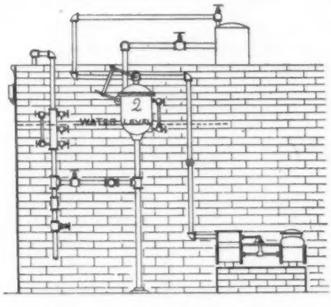


FIG. 8.—APPLICATION OF REGULATOR TO TUBULAR BOILER.

purpose of showing the proper water level, and nothing that can possibly disturb this water level should be permitted. However, there is no circulation of water or steam through the boiler feed regulator, therefore it cannot easily cause trouble along this line.

Inside of the regulator there is a hollow float that rises and falls with the water level in the regulator chamber, and as this is connected at both top and bottom to the boiler by pipes of ample size, it should be as reliable as a water column. This float operates the lower outside lever (at the left of the regulator), and is connected by a link to the upper level which is on the stem of a balanced valve in the steam pipe, that shuts off steam and stops the pump when enough water is secured, and turns it on again when more is wanted. The water level can be raised by adding weight to a lever not shown in the illustration and it is lowered by reducing the weight carried.

LETTERS ON PRACTICAL SUBJECTS.

HIGH-FREQUENCY TESTING APPARATUS.

It is often desirable to test apparatus or devices with "static electricity" in order to determine their behavior during the passage of high-frequency currents. As a static machine is not a direct source of income it is never included in the equipment of electric power systems. So the efficiency of devices in reducing the strains to which appafatus must be subjected during the passage of high-frequency currents is determined by experience rather than by actual tests.

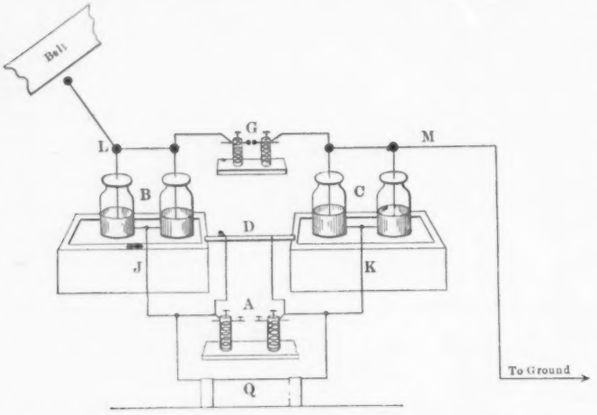


FIG. 1.—HIGH-FREQUENCY TESTING APPARATUS.

Where there is a running belt highly charged with static electricity a static outfit similar to the one shown in Fig. 1 may be improvised. As Leyden jars are the condensers most generally used, these are shown. This condenser is made of a wide-mouthed glass jar of gallon size. The thickness of the glass is 1/10 in. The lower half of the jar is coated with tin-foil both inside and outside, the tin-foil being made to adhere closely to the surface of the jar by a thin coating of copal varnish or shellac. A cork of dry wood or other good insulating material is fitted into the mouth of the bottle and a brass rod runs through its center. The rod projects below the top of the tin-foil and ends in a ball or rounded surface at the top end. Wires are attached to the lower end of the rod and arranged so that they touch the inner surface at several points, thus affording several paths from the inner coating of the jar to the rod for the passage of the charge when the jar is discharged. As the inner coating of the jar and its circuits are more easily insulated than the outer coating, this coating is connected to the source of electricity, and as there will be free electricity on these conductors they should be large enough to prevent leakage. Tubular conductors offer much less impedance than solid ones and should be used to secure the best results.

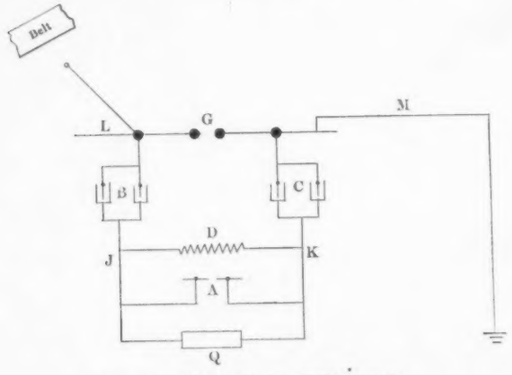


FIG. 2.—DIAGRAM OF CONNECTIONS.

Referring to the illustration, the inner coating of jars, *B*, are placed in one circuit by connecting the rods together. The outer coatings are also connected together by passing wires around each jar over the tin-foil and connecting them together, or by placing the jars on a sheet of metal. The jars, *C*, are connected up in the same manner. There should be the same number of jars of the same capacity in *B* and *C*. Jars *B* and C are shown resting on a sheet of glass supported by a box. Care should be taken to have the glass large enough to prevent leakage over the edges. Other ways will readily suggest themselves so that one will be able to improvise adequate insulation from the means at hand or easily obtainable.

The conductor, *L*, should be placed in close proximity to the charged belt, while the conductor, *M*, should be grounded. The adjustable spark-gap, *G*, should be connected between *L* and *M*, as shown in the illustration. The frequency can be varied by varying the length of this spark-gap. The apparatus, *Q*, to be tested is connected between *J* and *K*. In shunt with the apparatus is placed the needle gap, *A*, for measuring the equivalent needle gap of the device if this is what is desired. As the jars charge up there will be a passage of static electricity from *J* to *K*. It is not desirable that this should pass through the apparatus or across the needle gap, so a high resistance, *D*, is interposed between *J* and *K* for the passage of this charging current. If a megohm carborundum resistance rod cannot be procured a high resistance can easily be improvised by making a heavy lead pencil mark on a piece of ground glass or soft glass tube roughened with a file. Conductors should be fastened to the glass so as to make good contact with the ends of the pencil mark, and then a coating of varnish or shellac should be applied. If only a portion of the glass tube is used for the resistance the tube may be mounted on the supports, as shown in the illustration. With this apparatus one may perform many tests and gain much practical information.

Very often an induction static machine loses its excitation. The inductors are not always in an accessible position so that one can charge them by influence. If one end of a wire is attached to one pole and the other end placed near a running belt and then the other pole of the machine is grounded, the machine will receive sufficient excitation to make it pick up immediately if it is in working condition. Sometimes the plates and interior of the case are so damp that the electricity escapes at such low voltage that it is impossible to make it pick up until thoroughly dried out. Fig. 2 is the usual convention for representing the above apparatus.

SCHENECTADY, N. Y. D. S. CARPENTER.

BETTER PIPE WRENCHES NEEDED.

Since Bessemer steel is now used for almost everything formerly made of iron, it is high time that a change were made in the form of pipe wrenches and tongs used in making up pipe joints. It should be noted in this direction that the old-fashioned "pipe tongs" have nearly all disappeared; Stillson wrenches being used instead. This is a step in the right direction, but this wrench also needs redesigning in order to meet modern conditions and pipe requirements. Since steel has come into extensive use as a material for pipes, its greater strength has made it possible to use thinner tubing and still carry the same steam pressure. As a result of using pipe with thin walls, the old-fashioned pipe tools indent and mar the thin piping to such an extent that many pieces are utterly ruined while being screwed home. Add to the imperfect forms of pipe wrenches used the habit possessed by some people of habitually screwing pipe joints until they are unable to turn the wrench another fraction of an inch. In this manner pieces of pipe are ruined, and in many cases leakage is developed which never would have occurred had proper care been exercised.

The old-fashioned pipe tongs engaged the pipe in a single straight line, quickly forming an indention which sometimes broke through the wall and caused leakage. The Stillson

wrench has a slightly wider arc of contact with the pipe, and in doing heavy work the pipe is flattened by the pressure until the arc becomes a chord of sufficient width to sustain the pressure applied. Thus, while the pipe tongs punch holes in pipes and Stillson wrenches flatten them, a new tool is needed which can be used as expeditiously as the Stillson, but which will not flatten or tear the pipes. Something of this kind is a necessity in the pipe-fitting world and must soon be forthcoming. Devices are in use for handling finished brass pipes, and a sort of "web-friction" machine is also used for the same purpose, but there is need of a pipe wrench device which shall give bearings in half a dozen portions of the pipe circumference instead of on two parts as at present. Such a tool, besides filling the traditional "long-felt want" will permit pipes to be put up without being flattened or split, and, what is still better, pipes could be taken down in good condition to be used again for other first-class work. Just what shape the jaws of such pipe wrenches will take, the writer is not fully prepared to state, but that such tools and appliances are very badly needed at once, he is prepared to demonstrate in season and out of season.

NEW YORK CITY. HENRY JAMISON.

WIRING FOR VOLTMETER CONNECTIONS.

Referring to Mr. Joseph Thomas' letter in the February issue regarding switchboard voltmeter connections, assuming that Fig. 1 shows voltmeter connection to the outside or dead side of a feeder circuit, and that the heavy lines indicate generator leads, this arrangement is objectionable inasmuch as it necessitates the feeder circuit switch being kept closed while the generator is building up, and no practical dynamo man wants the load connected up until he has his e.m.f. built up to its normal potential. The arrangement shown in Fig. 2 is unsatisfactory for much the same reasons, with this difference, that the generator cannot be built up without being connected to the bus-bars. In both cases the potential is taken from the main busses, which certainly is not good practice, and which, in parallel running, would be found impracticable. I have frequently seen voltmeters connected up in this manner, but in every case that I can now call to mind, they were small isolated plants, with lighting loads only, where the engineer never took the trouble to open his main switch when

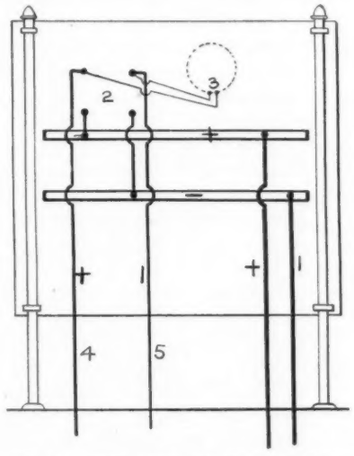


FIG. 1.—REAR VIEW OF SWITCHBOARD.

shutting down, and, when starting up, built up his machine with the load on.

A very much better arrangement, and one that the writer has found extremely satisfactory, is shown in Fig. 3, where *G* denotes the generator with its leads running to the lower terminals of the main switch. From this point two leads are taken, one from each switch stud, directly to the binding posts of the voltmeter. Thus, it will be seen, the circuit from the generator to the voltmeter is always closed, and the potential of the generator can always be built to normal without closing the main switch. Obviously, this method will also prevent the generator at full speed and no voltage having its circuit suddenly closed on full load, with the consequent strains on bearings and insulation.

In cases of parallel running, but one voltmeter is necessary, in which case each generator would be supplied with a volt-

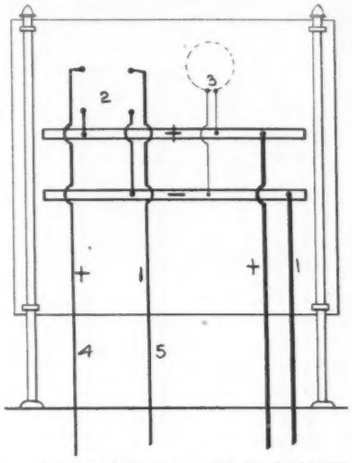


FIG. 2.—CONNECTIONS ON BACK OF SWITCHBOARD.

meter receptacle, with but one plug between them, and care should be exercised to see that the voltmeter plug is always in the receptacle belonging to the incoming machine. Where two or more generators are feeding in parallel into the same busses, it is the best practice to have one generator voltmeter, and another voltmeter to indicate the potential of the main bus bars.

This is commonly called the total load voltmeter, and in plants of considerable size, it is sometimes mounted on a separate panel, called the total load panel, together with the total load ammeter and watthour meter. In this case the voltmeter is connected directly across the bus-bars, and the am-

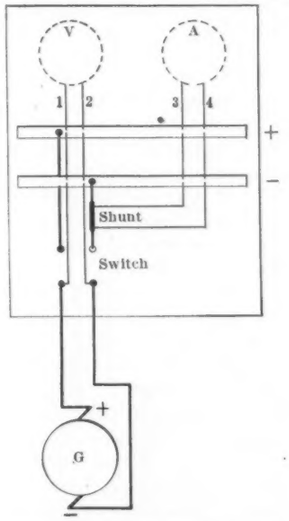


FIG. 3.—MR. SAUL'S DIAGRAM OF CONNECTIONS.

meter shunt is in series with the negative lead from the generator or negative bus, as the case may be.

BUFFALO, N. Y. A. P. H. SAUL.

In answer to Mr. Thomas' query in your issue of February I would say that the proper connection for the voltmeter would be between the generator and main switch (although it would make no special difference in this case) as it would then be

possible to obtain a reading whether the main switch was closed or not. If it is desired to measure the potential at more than one point of the system, this may be done by installing a multi-point voltmeter switch. I would also suggest that it would be better to install the main switch between the generaor and the bus-bars. If another generator be installed to operate in parallel with the one already in, the above method of connecting would be necessary.

Springfield, Wis. R. E. Gibbs.

LITTLE STEAM LEAKS.

The manager who is constantly on the lookout for little leakages, is the man who succeeds, provided that he finds and stops the leaks. There is probably no waste so persistent and serious as the leakage of steam into the atmosphere without having first done some useful work. It does not require a large hole for a dollar's worth of steam to escape through, and where there are many drips and drains in a steam plant, the leakage is serious. For example, consider that a drip valve from a radiator in the office is left open one-half a turn over night. A small cloud of steam has been escaping for fourteen hours and the manager has not noted the waste more than to try to close the valve until it is tight.

Just investigate and find out exactly what that and other leaks are costing you. First, ascertain what the factor of evaporation is, and see how many pounds of water is being vaporized by one pound of coal. It makes no difference what use is made of the steam; just find the ratio between coal burned and water evaporated. To do it, weigh the water, coal, and ash for a period, and find how much coal it takes to evaporate 100 pounds of water.

Suppose, for instance, that each pound of coal burned, takes care of nine pounds of water. Should the coal cost $4.00 a ton, one pound of coal is worth 1/5 cent, and it costs 1/9 of 1/5, or 1/45 cent to evaporate one pound. Rig up a makeshift apparatus for handling the steam and drip from any leaky valve with which it is desired to experiment. For this purpose, the writer at one time rigged up a little wagon, with an ordinary 800-lb. platform scale. A tight barrel was mounted on the scale and a rotary pump was fitted in the barrel in such a manner that the shaft projected through a hole in the staves. A felt packing prevented any waste of water around the shaft, and a coiled pipe was rigged inside the barrel in such manner that the steam from any leaky pipe could be turned into the barrel pipe and a stream of water from the pump, caused to circulate through the pipe with the waste steam. This arrangement was for the purpose of condensing the water which escaped as steam, also to catch the very hot water which came from the pipe, without permitting any of the steam to escape. The scale was accurately balanced after some water had been placed in the barrel, and the pump worked a little to make sure that it was in good order. The waste pipe was connected with the circulating pipe inside the barrel by attaching a few fittings to the end of the waste pipe in such a manner that rubber hose could be slipped tightly over the last of the fittings.

The time should be taken the instant the pipe is attached and the pump should be kept in motion until the rubber hose is disconnected. Take the weight of the apparatus again, deduct one amount from the other, and the remainder is the amount of condensation from the pipe during the trial.

Should the weight of water in the barrel have increased in 30 minutes 40 pounds, it means that the little leak is wasting water at the rate of 80 pounds an hour, or 800 pounds a day of ten hours. This means, that at $0.000222 a pound, $0.1776 cents a day is the price paid for that particular leak. For a year, 10 hours a day, 300 days, the leak will cost $53.28, and 24 hours a day, 365 days a year, the leak costs $120.06.

It should be remembered that this cost is for only one leak. There may be a dozen leaks of similar magnitude, and then the bill for wasted coal will amount to over $1,440 for the twelve months. Surely it will pay to spend a little time mending the leaks as fast as they develop. Another thing which the above described apparatus should be adapted to is for attaching to a valve stem out of which steam is hissing at the rate of dimes an hour. It will not require more than one demonstration of this kind to show the engineer or fireman that he is working harder than necessary for the purpose of hearing steam hiss out of valves which need repacking.

The apparatus may be attached to almost any kind of leak by means of rubber hose. Split the hose a little at or near one end, place it over the leak and bind fast with adhesive tape. It requires but a very little ingenuity to fix a leak in this manner. The amount of steam which is intercepted on its way to waste, through a leak of this kind, will scarcely be believed by anyone who has not made the test.

New York City. James Francis.

HANGING HIGH-TENSION INSULATORS.

Referring to the drawing in the letter of Mr. F. G. Baum, published in a recent number of the Electrical World, in which he says that it is hoped the design offered will bring out other ideas on the matter, I would suggest why not in-

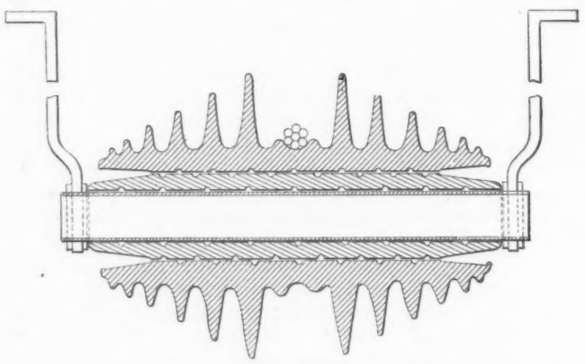


FIG. 1.—HANGING HIGH-TENSION INSULATOR.

terchange the line and the pin as shown in the accompanying drawing, Fig. 1, placing the insulator on a hanging pin to overcome the disadvantage of having to string the insulator on the line, when first put up and avoid cutting it or having to make the special fastening he shows.

For mechanical strength the pin in this scheme would be eight times as great for the same length, being a pin fixed at both ends with a load uniformly distributed on the pin (the load on the insulator being the middle) against a pin fixed

FIG. 2.—METHOD OF HANGING WIRES.

at one end and loaded at the other, or the pin could be made eight times as long with the same bending moment.

The wires are hung on the insulator as shown in Fig. 2. The drawing does not show any particular designed insulator, but is simply given to convey the idea, and the merit of a properly designed insulator from the mechanical and electrical standpoint remains to be shown.

Mill Valley, Cal. Otto E. Falch, Jr.

GRINDING IN VALVES.

Every power house should be provided with a set of special tools for regrinding stop and check valves and when such tools are provided they should be used freely. No good en-

gineer will tolerate a leaky valve; but many owners are not capable of being educated to understand that valve files and similar appliances are tools in which it pays well to invest. An engineer will not find it easy to keep valves tight with no toll except a monkey wrench and a hammer. All valves of the loose disc, or "Jenkins type" are readily made tight by putting in new discs except when regrinding the seat is necessary; but the solid disc, metal to metal valves require frequent resurfacing of both disc and seat, in order to keep the valves tight.

There is no trouble in keeping a valve tight which contains sufficient metal to withstand the strains of the steam pressure, but several makers of steam fittings place upon the market "competition" valves which are of little value. A one-inch valve, to be of value, should weigh three or four pounds; the "competition" one-inch valve weighs 1¼ pounds. In fact, it is, as one engineer described it, nothing more than "a hole with a brass skin around it." Valves of the "competition" class can never be reground to advantage, for the simple reason that they do not carry enough metal to make regrinding possible. The seats of these valves are often so seriously distorted by steam pressure that they can never be made tight again. If a valve of this kind is found in the steam connections, the engineer is justified in putting that valve out of commission as speedily as possible.

Most stop valves can be readily re-ground by removing the bonnet, removing the disc from the end of the stem, then replacing the disc with a piece of packing or a washer between the disc and end of stem against which the disc is made fast by screwing the disc nut hard against the packing above mentioned. Some water should be placed in the valve, with a little sand or pulverized glass, and the grinding started by revolving the disc and stem back and forth by hand.

It is not good to use emery in valve-regrinding, as it becomes imbedded in the metal of seat or disc, and remains there, cutting the metal whenever it comes in contact with it. The sand or pulverized glass which is sold for valve grinding goes all to pieces during the grinding operation. The sand wears out and comes away in mud, and does not remain imbedded to cause future trouble.

Some valves are so made that the bonnet may be replaced and used to guide the stem during regrinding, but this is not necessary, for the reason that the diameter of the disc or seat is great enough in any valve to permit it to be kept upon the seat during the regrinding process.

Some valves are so made that the hand wheel may be removed and the stem caught in an ordinary brace, or bit-stock, for the work of regrinding. The writer prefers a breast-drill to a bit-stock, since the regrinding is done with greater ease and economy of time.

A most excellent tool for holding discs in place while they are being reground is a piece of steel having a shank like an ordinary bit to fit the breast-drill chuck. On the extreme end of the tool is a flat disc or collar, about ⅝-in. in diameter and ⅛ in. thick. To use this tool remove a disc from a valve-stem and put it on the tool just described, holding disc and tool together in the usual manner with the collar-nut belonging to the disc. A great many different sizes and shapes of discs may be attached to the tool described, and a few turns of the gear-crank soon reduces disc and seat to clean bright surfaces. By slipping a washer over the chuck-end of the tool, it can be made to receive almost any size of disc. If a little care is taken in centering the tool when it is fitted to the disc, there will be little trouble in grinding tight.

Several of these little tools are made of different diameters and lengths, from ¼ in. by 6 ins. to ¾ in. by 12 ins., and kept for handling discs of valves ranging from ⅜ in. to 8 ins. in size.

It is not always possible to obtain pulverized glass for grinding valves, but it is little trouble to make it in the quantity necessary. Procure some window glass or old bottles, and place them on something solid. Next secure a piece of iron, say a piece of 2-in. or 3-in. shafting, 12 ins. to 24 ins. long, and tie a piece of heavy cloth around one end of it so that when the iron is used as a pestle for pounding the glass on the prepared foundation, the cloth spreads out on all sides and prevents the scattering of the pulverized glass. A piece of wire cloth about 40 or 60 mesh should be used for sifting the powdered glass, and any portions which fail to pass that mesh should be returned again to the pulverizing apparatus, until a sufficient quantity of glass has been obtained.

SCRANTON, PA. JOHN SCOTT.

BELL WIRING SYSTEMS.

In glancing over the Questions and Answers department of your January issue, I find an inquiry on how to wire a building for seven bells in different locations, each bell to ring separately from its individual push button and all the bells at once from a master push button. I send herewith a diagram of a system that I install in hotels and hospitals, where it is desired to ring one bell at a time and in case of fire to

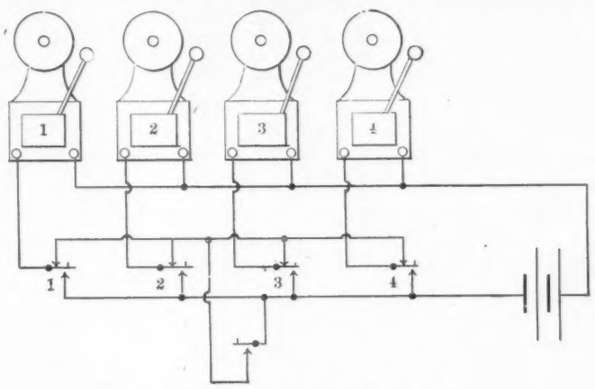


FIG. 1.—MR. FRANK'S BELL WIRING DIAGRAM.

ring all at once. Three-point push buttons are used and in the diagram it will be noted that the contact from the section wires and from the common wire from the master push button are in connection only as long as none of the three-point push buttons is pressed. When one of these is pressed it relieves the contact from the master push button wire and touches the battery wire contact, thus ringing the desired bell only.

NEW YORK CITY. L. G. FRANK.

Answering E. J. N's inquiry in the January number, I beg to submit another plan for solving his problem. In the

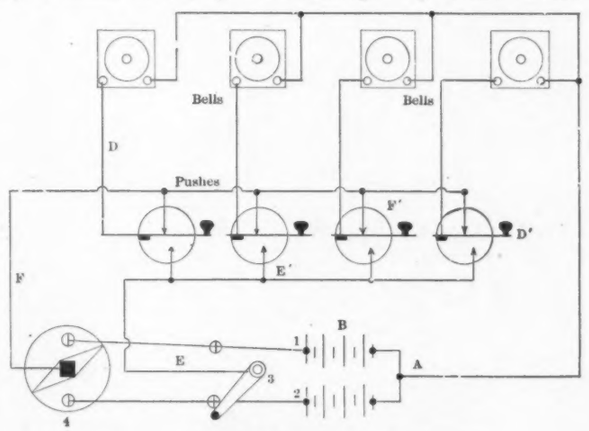


FIG. 2.—MR. DIMOCK'S BELL WIRING DIAGRAM.

drawing, Fig. 2, I have shown only four bells, etc. On each button is a closed circuit contact spring, *F'*, to connect wire, *F* to multiple switch 4. The main spring, *D'*, is connected with the bell, and the spring, *E'*, to the battery switch, 3. These

three-point push buttons can be purchased in most electrical supply houses, or one may use three-wire strap keys, the top contact being closed and the bottom contact open. Switch 4 rings all the bells simultaneously and uses all the battery, while for the individual call bell work only part of the bat-

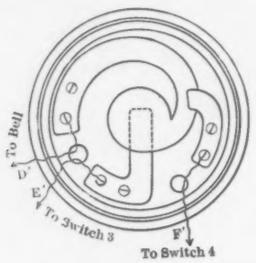


FIG. 3.—THREE POINT PUSH BUTTON.

tery is used. A two-point switch 3 is used to change from one battery to the other if one should become exhausted or weak. The batteries should be connected in multiple series. Two series of four cells each will be enough for seven bells if the distance or resistance is not too great.

Brooklyn, N. Y. W. K. Dimock.

AN ELECTRIC LIGHT CALCULATION.

I wonder how many readers of the Electrical World would be able to find the lamp equipment of a plant if they were given the amount of the bill, the meter reading, the rates for energy and the lamp consumption in watts; especially when the rate is of the kind so commonly used yet complicated, such as 10 cents for the first 50 hours and 2 cents for the balance. I have met with such a problem at times and have worked out a rule which I thought might be of interest.

We will take for instance the following example: Meter reading, 168.3 kw-hours; bill, $6.86; rate, 10 cents for the first 50 hours, 2 cents for all over; incandescent lamps used having a watt consumption of 56 watts each. Solving by algebra, we have the following equations:

Let x be the kw-hours at 10 cents; then $168.3 - x$ will be the kw-hours at 2 cents. From this it follows that $10x + 2(168.3 - x) = 686$, or $8x = 349.4$, whence $x = 43.8$ kw-hours used in the first 50 hours. Then $43.8 \div 50 = .876$ kw, or 876 watts in one hour, and $876 \div 56 = 15.6$ lamps, or allowing for over consumption, 15 lamps.

Now in order to get the rule it is necessary to go back to the original equation: Thus, $(10 - 2)\ x = 686 - 2\ (168.3)$. The kw in 50 hours are $686.2 - 2\ (168.3) \div (10 - 2)$; and the kw per hour $= 686 - 2\ (168.3) \div 50\ (10 - 2)$. The watts per hour are then equal to $1{,}000\ [686 - 2\ (168.3)] \div 50\ (10 - 2)$. Dividing this result by 56 will give the number of incandescent lamps in the equipment. From this the following rule may be deducted:

Rule.—From the bill expressed in cents deduct the product of the second rate and the meter reading; dividing the difference multiplied by 1,000 by the product of the hours, lamp wattage, and the difference in the rates. The equipment, allowing for over consumption, will be represented by the quotient thus obtained.

Baltimore, Md. Edward K. Stembridge.

EXPANDING THE BORE OF A TURBO-GENERATOR FIELD.

Trouble was experienced from the creeping of a 7,500 kw, four-pole turbo-generator field upon its shaft and the field and shaft were returned to the factory for repairs. Five hundred tons pressure failed to start the shaft and as the capacity of the press had been reached additional aid had to be secured.

It was decided to heat the field and expand it, thus causing it to release some of its grip upon the shaft. A ready means appeared to be to pass current through the field, but several questions presented themselves. Alternating current would, of course, heat faster by adding iron loss to loss in the windings. It was equally plain that this iron loss would appear in the shaft and heat it also, thus defeating the purpose of the expansion. Would direct current heat the field rapidly enough without injuring the windings? What would the power factor be? How much would the bore expand? The peculiar shape of the mass made this difficult to calculate. Should the poles be connected in series, or in parallel?

About 300 amp. direct current were applied. The temperature of no part was allowed to rise above 90° C. In about six hours the shaft started and was pressed out. The average temperature was 80° C. The temperature of the shaft had risen but a few degrees. A new shaft was made and the field rebored. Now alternating current was applied, 220 volts being used, and resistance control. After some experiment, the poles were connected in parallel, two north and two south, and a power factor of 80 was obtained with 75 amp. In about ten hours the field structure had reached an even temperature of 95° C. and the bore (24 in.) had enlarged 0.022 in., nearly twice the computed amount. The new shaft was now easily pressed home and a very satisfactory fit assured.

Wilkinsburg, Pa. V. W. Shear.

A "WOBBLING" ARMATURE.

The writer has lately been having trouble with a generator which sparked badly and rattled in its bearings. The shaft was taken out and the whole carefully balanced. It was found to be considerably out of standing balance, and the machinist added weight by means of solder, until the shaft would stay in any position on the levelled straight edges. But, to the surprise of the machinist, the rattling and sparking was as bad as ever when the generator was started again. Another very close inspection of the armature, with the shaft suspended between the centers of a lathe, revealed the fact that the shaft was slightly crooked.

A strain was put upon the shaft by means of a jack-screw, and the shaft almost entirely straightened by that means. Still, this failed to stop all the rattling and vibrating. Finally, it was decided to procure a new armature and shaft and during the preliminary taking of measurements, with the shaft in the latter, it was noticed that a portion of the armature winding seemed different from the rest of the winding. A close inspection revealed the fact that some of the armature coils had been replaced at some time or other, and that the wire in the new coils was smaller than the rest of the wire in the armature coils.

This left one side of the armature lighter than the rest, hence the rattling, and the eccentric performance of the shaft. To cure the trouble the armature was mounted in the lathe with a long limber tail center, made from spring steel and barely stiff enough to hold the armature steady.

With the armature thus mounted, the lathe was started and the armature carefully watched to see that the shaft did not jump out of the lathe. The "high" side was marked with chalk and the light side was loaded with solder and sheet lead and then tried in the lathe again. To the surprise of the workmen, the eccentricity of the revolving armature was found to be on the opposite side, so some of the lead was removed until the shaft ran fairly true on the limber tail center, after which the other end of the shaft was tested.

Two trials resulted in making that end run fairly well, after which the first end was tested again, and the counterweights again changed a trifle. It was to be regretted that a flexible head center was not made and used, but there was no opportunity to do so, as the repair job was a rush one which had to be done off-hand. When the armature was finally replaced in its bearings, it was found to run quiet, and it has given no trouble during the several weeks which have elapsed since the repairs were made.

Willoughby, Ohio. James F. Hobart.

QUESTIONS AND ANSWERS.

What is the greatest distance through which electricity has been commercially transmitted? C. DeP. F.

232 miles at present, from De Sable to Sansilito, by way of Cordelia, Cal. The proposed line from Victoria Falls to the Rand, Transvaal, Africa, will be about 700 miles long.

Is it possible to fell trees by electricity? If so, how is this done? J. S.

Yes. A wire is heated to red or white heat by means of a current of electricity passing through it and this is used to literally burn its way through the trunk of the tree.

If I connect a single-phase wattmeter in one side of a three-wire, three-phase motor circuit, to which pair of lines does the pressure coil connect to get the true watts? E. H. W.

When the circuit is balanced, connect the current coil in one wire and the free terminal of the shunt coil alternately to the other two leads. The sum of the readings is equal to the power.

Kindly advise me which system is best to use in connection with a grounded telephone exchange. Would it be better to ground each of the 50 telephones separately, or would it not be better to run a wire on the poles and connect all the ground wires from the telephones to this wire and then to ground it? J. P.

It would be better to ground each telephone instrument separately, for should any fault occur in the ground connection it will affect only the instrument to which it is connected; whereas with the other scheme all the instruments would be affected.

We have a group of houses located very near together and each house carries a 10-light transformer. We doubt whether the maximum number of lamps burning in all the houses at one time ever exceeds 30, and then only on very rare occasions. The number of transformers thus connected is six. Would it not be possible to replace these with a single transformer? What saving would result? S. T. O.

The six transformers could be replaced with a single 30-light transformer with material saving. The loss in a 10-light transformer is at least 40 watts, while the loss in a 30-light transformer ought not to exceed that amount. A saving of about 200 watts is thus effected by the change, or in other words in about two years the saving would purchase a 30-light transformer of the best type.

What is the Doherty rate referred to in Mr. Homer Honeywell's paper on "Outline Lighting" published in the February number? S. E. L. Co.

This rate was proposed by Mr. Henry L. Doherty in a paper on "Equitable, Uniform and Competitive Rates," before the National Electric Light Association in 1900. The system consists of making a charge for "readiness to serve" and an additional charge per kw-hour for the actual service. The charge for readiness to serve is based on the maximum demand of the consumer, and fuses or some other device are used to prevent the consumer exceeding the demand. As originally carried out, there was a fixed charge of $3 per consumer per year, in addition to $3 per meter per year; $1.50 per lamp demanded per year in addition to a meter rate of 5 cents per kw-hour. Various modifications of the system of charging are in use.

We are contemplating a day circuit for motor service and would like to know if you would consider it advisable to install 125-cycle motors. F. E. Co.

The principal field for systems operating at a frequency of 125 cycles is in small distributions of scattered load, and where secondary networks, if there are any at all, are of little importance. This frequency is used almost entirely for lighting, although a small percentage of motor load can be carried without trouble. Transformers as a rule, size for size, have a better efficiency at a higher frequency, and motors run at higher speeds. This is especially true with single-phase induction motors, which type is undoubtedly the most commonly used for 125-cycle installations. Generators operating at this frequency are usually of small capacity and can rarely be operated in parallel owing to imperfections in the governing powers of reciprocating steam engines.

To what extent do changes in the voltage and frequency of a circuit affect an induction motor connected to that circuit? A. M. C.

Since the slip of an induction motor varies inversely as the square of the applied e.m.f., greater relative changes in speed will occur when the voltage is below normal than when it is above normal. Thus, supposing a slip of one per cent at a normal pressure of 100 volts, the slip at 80 volts will be 1.5 and at 120 volts 0.7. The torque is roughly proportional to the inverse square of the frequency, so that any diminution of the frequency will increase the torque. Thus a two-phase, 200-volt, 30-cycle motor may be operated on a 60-cycle circuit, provided the voltage is increased to 283 volts. In this case the torque will have half its normal value and the speed will be doubled. The slip will be less, since only half the torque is developed, and the starting torque is less since the voltage is not increased in proportion to the frequency.

Will you kindly explain through the columns of the ELECTRICAL WORLD how two generators are phased? Is it possible to use just two transformers to phase two generators? A. W. B.

The potential transformer which supplies reduced voltage to the voltmeter and to the synchronizing busses has its primary connected across one phase of the generator, whether the alternator be two-phase, three-phase or single-phase. The secondaries of the transformers are connected in series through incandescent lamps. If the transformers are connected similarly in the two circuits, then when the generators are in phase the e.m.f.'s in the secondaries will be in phase and no current will flow through the lamps; and when the generators are out of phase the e.m.f.'s in the secondary circuits will be of phase also and current will flow through the lamps. The amount of this current and the resultant brilliancy of the lamps depend on the difference in phase. The connections of either the primary or the secondary of either transformer may be reversed if it is desired to change the indications in the lamps; that is, to have the lamps at maximum brilliancy when the generators are in phase or vice versa.

I am in charge of a plant generating three-phase, 60-cycle current at a voltage of 480. The load is made up of three-phase induction motors operating at the generated voltage. The equipment is General Electric throughout and that company's compensators are used for starting. As all the machines must run from 6.30 A. M., Monday morning, until noon, Saturday, I wish to know of some way of connecting in and constructing some apparatus which can temporarily take the place of the starting compensators in case of a burn-out in the latter. As a contingency such as referred to is apt to happen any moment and would entail costly delay while being repaired, your suggestions will be greatly appreciated. W. J. S.

Use a three-pole, double-throw switch. Connect the service, say, to the three left-hand jaws and connect the motor to the hinged contacts on which the switch blades revolve. Across the outer left-hand and right-hand jaws connect a resistance, and across the middle jaws connect a jumper. The starting side of the switch will be the right-hand side, and the running side of the switch, the left-hand side. For a 50-hp motor each of the resistances across the outer jaws may be made of about 100 ft. of No. 14 galvanized wire wound in spirals and submerged in a barrel of water. For smaller motors less wire is necessary.

I understand that the inspectors of the National Board of Fire Underwriters have a short method of determining whether a motor has been properly wired or not; that is, whether the wire installed is large enough to feed the motor and comply with the requirements of the National Electric Code. I should be pleased to know this method. P. A.

For motors rated in horse-power, if the voltage is 110, the inspector multiplies this by 8 and increases the product 25 per cent. He then refers to his table to determine what wire will carry that many amperes. If the voltage is 220, the multiplier is 4 instead of 8, and so on. Where the motor is rated in amperes and volts, the ampere rating is increased 25 per cent or more and the wire installed to carry this amperage.

CENTRAL STATION SALE OF CURRENT

Does Advertising Pay a Central Station?

By Carmelita Beckwith.

That a central station must advertise is conceded, though it has been but a few years since the fact has been realized. The question is, which is the better method to obtain results? Each central station manager has his own individual problem to work out, but the experience of others is of benefit, if only as a basis of comparison.

The advertising and business-getting methods employed by The United Electric Light & Power Company of New York are of recent date; in fact, it was only two years ago that the company started its little magazine, "Lights and Shadows," a tiny booklet, issued monthly, the United company being one of several to use this method of exploiting its product. The results obtained were encouraging, and this year a small publication is prepared and distributed throughout the city. It contains details and illustrations of various installations on the company's alternating current mains; tells also of the broad possibilities of electricity in adding to the convenience and comfort of everyday life. On the theory that existing customers are interested in electrical development, the booklet is mailed regularly in the monthly bills. It is also sent to electrical contractors, architects, builders, real estate brokers, the technical editor of every newspaper and to the reading room of each public library.

FIG. 1.—ROOF SIGN.

FIG. 2.—FENCE SIGN.

While it is almost impossible to trace direct results from this sort of publicity, during the past year, the amount of energy consumed by each of the United company's customers increased perceptibly, showing that many of the labor-saving devices described were put into daily use.

The alternating-current mains of the United company are widely distributed over Manhattan Island, from the Battery to Harlem River; the district above One Hundred and Thirty-fifth Street is exclusively supplied by this company. The growth of this territory might be said to be fast and furious; at least, so it appears to the person who visits it now for the first time in two or three years. Reached by subway, elevated and surface cars, this district has been electrical in its development. About eighteen months ago the United company started a campaign of publicity in Washington Heights, using fence signs in prominent places, usually at busy corners where crosstown and main avenue cars pass continually. This is a form of advertising still new to electric companies, but it has been found advantageous and result-bringing. The signs ranging in size from ten feet to one hundred feet long by ten feet high, are painted in an artistic and attractive manner, as will be seen from the illustrations on this page. They are changed three and four times a year, each time bringing out the name of the company together with a short, crisp sentence, suggesting the use of electricity, such as "Do it with Electricity," "Don't be an old Fogy," "Use Electricity" and "Cheap Rates." A number of signs of this character are now being used by the United company at a nominal cost when the amount of publicity is considered. In addition to these fence signs, fifty painted bulletin boards, 5 ft. x 3 ft. have been placed on the sides of retail stores at the corners of main thoroughfares in the Washington Heights section of the city. The most prominent of these fence and bulletin board signs are brilliantly illuminated by incandescent lamps and reflectors.

When asked as to the results of this campaign of this unusual and striking publicity, Mr. Frank W. Smith, secretary of the company, said: "I do not know that I can give you the exact figures of the increase in lamp equivalents, but you can judge for yourself when I tell you that this company's subways

FIG. 3.—TYPE OF FREE SIGN.

have been extended nearly thirty-six miles during the past year, more than fifteen of which are in the Washington Heights section, covering new streets where electric service was not available. We believe that the liberal extension of our underground mains has contributed in no small degree to the rapid growth and development of this territory."

The first of this year the United company inaugurated a power campaign, comprising thirty pieces of advertising matter to be mailed during the ensuing months. It includes a series of personal letters, signed by the individual solicitor in charge of that department, the assistant secretary and secretary in turn, enclosing unstamped return postal cards; striking circulars, and booklets relating to electric power. So far but three pieces have been mailed; while the return replies have been in excess of one per cent, and the new business contracted for clearly justifies the campaign before it is fairly started.

The free signs distributed by this company are a distinct change from the stereotyped form usually used by central stations, as will be noted from the one illustrated. Nearly 500 have been connected in service, the average income the year round approximating $100 each. In relation to this branch of the company's business, Mr. Smith said:

"The company in pursuing a liberal policy in distributing the signs has proved beyond a doubt that they have been largely instrumental in our securing business that otherwise would be lost. In a great majority of cases these signs are furnished to the small storekeeper, who would not think of making the original investment, yet when the sign is furnished free is almost lavish in the use of energy."

These free signs contain twenty-four 8 c. p. etched lamps; they are alike on both sides; and are furnished with a guarantee that the energy consumed will amount to at least $3.00 per month.

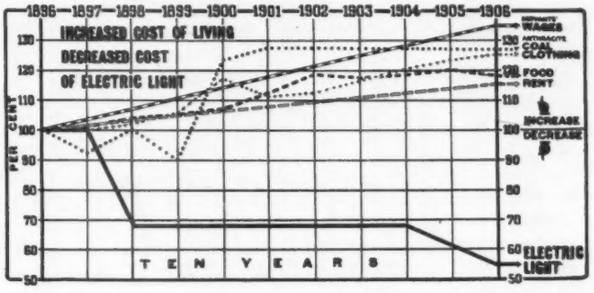
A map of Manhattan Island and the Bronx showing the company's mains and the route of the Subway is freely distributed serving to keep the name and aim of the company before architects, builders and kindred trades.

The personal canvass of dwellers in apartment houses within reach of the company's mains resulted in increasing the number of houses designated as "100 per cent" from 37 to 74; those of "50 per cent" from 51 to 85.

"That it pays to advertise," said Mr. Smith, in conclusion, "is as true in the case of an electric light company as any other business. The problem is how to do it and obtain the best results for the money expended. The increase in the United company's equivalents for 1906 are in excess of 17 per cent of the previous year's output; such advertising as we have done has no doubt contributed to this increase. It is always difficult to put your finger on exact results obtained from any one method of advertising; we have attempted to do this, and to some extent have been successful in particular branches; for instance, such as the free sign and power campaign and the canvass of apartment houses connected and being supplied from our mains. These all show a large increase, and as we shall continue our campaigns of publicity, our sale of energy will rapidly develop along the special lines exploited."

The Lower Cost of Electric Energy.

The Chicago Edison Company did a clever and effective thing recently by bringing out a large chart in colors showing how during the last ten years the cost of the other "old" necessities of life has gone up, while the price of electric energy has steadily declined. The table of curves is reproduced herewith in miniature, in black and white, giving its authorities, the company shows how rent has risen 15 per cent during the decade; food, 18 per cent; clothing, 25 per cent; anthracite coal, 27 per cent; servants' wages, 35 per cent; while electric light in the city has declined 45 per cent. "Nor is that the whole story: To the small consumer—the householder—who earned but little discount from the full rate of 20 cents per kw-hour, up to 1904, the price of electric light has been reduced considerably more than 25 per cent, as the full rate is now only 15 cents per kw-hour, and he can secure a double dis-



CURVES SHOWING HOW COST OF LIVING HAS INCREASED AND COST OF ELECTRICITY DECREASED.

count from that—one earned as before on the Wright demand basis and the other allowed him simply for paying his bills within ten days."

The Call for Current in Electric Heating.

By C. D. Wood.

There are two distinct methods of producing heat by electricity for use in the commercial world. The first and most common is that of forcing the current through resistance wires so that heat is generated and then applied to the article or vessel to be heated. The other method is to generate the heat by passing the current through the article itself. In this case the article forms the resistance. The process of electric welding is found under this latter head.

In sub-dividing the general field of commercial use of electric heat, we have chosen the following six headings: 1 Printing and Bookbinding. 2. Commercial Use of Irons. 3. Miscellaneous Manufacturing. 4. Laboratory and Scientific Uses. 5. Hotel and Restaurant Service. 6. General Heating.

The first heading affords one of the most interesting developments, and opens a field for serious endeavor on the part of the central station manager. The government printing office in Washington was the first printing house to adopt electric heating—the matrices used in printing the Congressional Record are dried by electricity. In this case the current is used at low pressure, and, through the medium of transformers, a wide range of heat regulation is obtained. The old type metal is melted for use again in vessels heated by the electric current. The bookbinding industry is discarding the soot-breeding gas flame, by substituting electric resistances, these resistances are placed next to the die in the embossing presses. The presses are operated at regular voltages, and require from two to twenty amperes, depending upon the size of the head to be heated. Nowhere has electric heating been so favorably received in the commercial field. Again, we find in big bookbinding and printing establishments glue pots, stripping tables, and case making machines, all operated by electric heat. I think it would be safe to say there are 500 glue pots in use in New York City, and consuming from one to three amperes, depending upon their size.

Under my second heading, the commercial use of irons, we find the hat industry using a large number of forming irons, which consume from three to eight amperes, depending upon the work to be done. We find here a possible application of the "homogeneous heating system" as installed by Mr. W. S. Hadaway, of New York City. This "homogeneous system" is the utilization of electricity to produce the necessary heat at high temperature, and exhaust steam from the electric plant to produce the required heat at low temperature. The hat manufacturers are using electric heat to operate their hand-shells, ma-

chine irons, veluring and shackle stores, curling machines, flanging bags and forming irons. Under this general heading we must include shoe irons, as the shoe factories of Massachusetts are heating their "treeing" machines with electricity, and most of the work upon the "uppers" is done by an electric iron. There is no time wasted in regulating and caring for this form of heat as we find expended in operating the old gas heated tool.

When there are delicate electric connections to be made, the soldering tool may be found in use. The manufacturers of switchboards and telephone supplies have adopted this device. An iron equal to a 1½-lb. soldering copper will consume about 70 watts of electrical energy. New copper tips may be inserted when necessary and the time saved on account of the constant heat supplied, enables the operator to do double the amount of work than with the old style gas soldering furnace. I know of a manufacturer in New York City, on the west side, who has been using steam at $30 per month and water at $25 per year to produce heat for treating wood in a special process. This manufacturer was persuaded to adopt electric heat. He found that he could carry on the process successfully using energy which cost him but $5 per month, at the lighting rates, making a total yearly saving of $325. This instance illustrates the economy found in special cases where electric heat may be adopted.

Under the heading of miscellaneous manufacturing we have the heating of japanning ovens and drying kilns. This class of work requires about 40 watts per cubic foot of air to be heated, providing the heating chambers are properly jacketed. Again, the cocoa and coffee trades requires a heat free from permeating gases—electricity provides this character of heat. For instance, a desiccating cocoa oven, containing about 35 cubic feet of air, requires 74 watts per cubic foot to raise its temperature to 150°; the bean is under ideal conditions while being heated. The candy manufacturers warm their chocolate dipping pots and drying pans with electric heat. In this class of business the cleanliness of electric heat is appreciated.

In the laboratory, I find the ether tests carried on by electric stoves, the presence of ether barring the open gas flame; in this case the absence of soot is appreciated by the chemist. He can use an electric immersion coil to hasten the action of his alloys, when the acids therein do not destroy the copper of the coils. He may warm his germ cabinets with electric heat, which cabinets are subject to an automatic thermostat regulation, thereby maintaining their temperature at the proper point. Every up-to-date dental laboratory is equipped with an electric furnace for inlay work, and the teeth molding machines may be heated by electric resistance. In the laboratories of New York City we find the first commercial application of electric heat.

Under our fifth division I shall include electric broilers which are seen in some of our large cafés. This development is a slow one, but the professional chef declares that there is no possible way of producing such perfect culinary articles as with the use of electric heat. We may find in some of our grill rooms a combination of oven, salamander and vertical broiler placed together upon one frame work. In our large hotels, such as the Waldorf, Belmont and Manhattan, there are complete electric laundries. In the western portion of the country we find the laundrymen have gone so far as to equip their 48-in. mangles with electric heating units, which formerly were operated with high-pressure steam.

Under our sixth heading, General Heating, we find but one class of work that has become universal, namely, the heating of street cars. Conditions peculiar to the operation of the street railway makes this proposition attractive to railroad men, but the many losses experienced between the consumption of the coal in the furnace and the conversion of electric energy into heat at the radiator make the entire heating of a building a proposition not welcomed by the central station manager, or the owner of the building.

Under the classification of electric heating apparatus, without the medium of outside resistance, we find track welding, tool hardening and "pipe thawing." The first two propositions are familiar to almost every one, but a few words upon "pipe thawing" might be of interest. Formerly, on the freezing of a water main, the plumber was called and he immediately set to work to open the frozen ground. This was an expensive and tedious method of removing the fault. To-day, the pipe is disconnected where it enters the building. One electric wire is attached to the outside portion of the disconnected pipe, the other wire fastened to the nearest hydrant. The flow of current through the resistance of the pipe produces heat, and the frozen portion is soon melted. During the winter of 1904-1905, one of our largest central stations handled 177 different cases of this kind. The average time consumed in actual thawing was 5.44 minutes, and the average amount of energy consumed was 1.3 kilowatt-hours. The pipes ran in size from the smallest, one-half inch in diameter, to the largest—a telephone conduit of three inches diameter.

Special cases of industrial applications are arising each day which require individual treatment, but we have endeavored to discuss only the more common utilities of electric heat.

Electrical Illumination of Show-Window Displays.

By W. H. Stuart.

The electric light solicitor can exercise a great influence in determining the character of show window dressing. To do so is as essential as the ability on the part of the motor solicitor to cope with the problems involving the cutting down of running expenses, floor space occupied and labor. With a judicious selection and arrangement of the lighting apparatus, the solicitor can increase the value of electric lighting for display, and should be able to show to a merchant expending a certain amount for advertising by circulating hand bills, sending out a wagon covered with painted signs or using canvas signs covering his premises, the advantage of a change in his methods.

You have seen a window with two, three or four rows of from four to eight incandescent lamps, running vertically up and down the corners, just blazing away, and though the window was crammed full of goods, in passing by you saw nothing but a glare. Next you will see a window lighted by one, two or three clusters, placed well up in the window, suspended by stems as long as the height of the window will allow without having the clusters too low, for the idea seems to be that people must see the stem, whether the lamps are doing their duty or not. Perhaps the window is graced by a chandelier of the Louis XIV period, or possibly one of the latest improved up-to-date American chandeliers with perhaps a few gas jets stuck on to give the money's worth.

Under no circumstances whatsoever try to illuminate show windows with a chandelier, no matter how expensive or how elaborate. It will be neither artistic nor successful. For instance, take a furniture store, exhibiting a parlor scene with piano, chairs, rugs, pictures, etc., with a wall background, and as if to make the scene more realistic, an elaborate chandelier of some twenty lamps placed to light the scene and the window. Now the scene and setting display neatness and taste, the different articles are expensive and out of the ordinary and yet there is something amiss—it does not attract, and simply because in the picture presented the chandelier is as much a part as the piano. It would improve the setting very much if small candle-power frosted lamps were used in the chandelier with outside means to illuminate the picture to the eyes of the public. In the case of a theatre setting the scene builder does not depend alone upon the chandeliers, the fixtures and table lamps, but flashes, by the aid of the foot and fly lamps, a vivid and impressive picture to the audience.

All a merchant is accomplishing by blazing away with a window full of visible lighting apparatus is to advertise the electric lighting company, at the same time paying the meter bills. A common instance of lack of judgment is in the use in

a window of a single nickel bar hung about three-quarters way up in the window, suspending six or eight incandescent lamps. The only service of such an electrical display is to attract the moths and the flies in the summer and goodness knows what in the winter.

Window dressing cannot always be improved by following certain set rules, but the basic principle of artistic, attractive and of course successful display is simplicity. Stamp an impression upon the minds of the public so that it will be remembered. Have the display taper to a special article or articles so that the attention and the thoughts are attracted to and then focused upon that for which the display is created. These are the principles of a display which will attract. All boiled down, window display can be expressed in the following three qualities: simplicity, force, concentration.

The source of illumination should be concealed from the observer and yet throw out the display clearly and distinctly without shadows and without glare. The only part of a window permitting such an arrangement is the top, and the best lighting apparatus for this case is the trough reflector. If the glass of the window should extend to the window ceiling and allows only about six inches of frame, it will be necessary to paint a strip across the top of the window glass or use a cloth window shade low enough to conceal the trough. It would be advisable to have the trough constructed so that no light is thrown upward. The number of lamps, the candle-power and the color of the light, are things to be considered when conditions are known. For instance, in the case of a furniture store using a sitting room scene with a red fire grate, the light should have a tinge of red and be more subdued than if the display is one of carpets or a general furniture exhibit.

One of the neatest and attractive displays I ever saw was used by a wholesale liquor dealer. In the center of a completely darkened window there had been placed a bottle of champagne. It rested upon the floor of the window, which was clothed in black velvet extending up the sides and back of the window. There was placed before the bottle a small trough reflector frame, painted black. Four two-cp lamps were used and their light was thrown upon that bottle and nowhere else. No matter

T. I. LACEY & SON
Architects
T. I. Lacey A. T. Lacey

Rooms 9 and 10 Kilmer Building
Eleventh Floor

Binghamton, N. Y., Sept. 4, 1906

BINGHAMTON LIGHT, HEAT & POWER CO.,
WASHINGTON ST., CITY

Gentlemen.—

Mr. T. I. Lacey desires to thank you. The fan afforded him a great deal of comfort th se hot days, he hardly knows what he would have done without it, and he wished me to assure you of his appreciation.

Yours truly
T. I. LACEY

how you moved around the window you could not see the lamps, but only the bottle standing out in a sharp contrast. That display cost exactly $2.80, the cost of the frame. The velvet had been purchased some time before and had been used on several other occasions. The lamps burned fifteen hours each day, from 5 p.m. to 8 a.m. every day in the month, the cost of which was $2.30 per month.

Another successful display was that of the largest thing possible to place in a window—an automobile. The salesroom of this automobile firm was situated in a corner building with a square floor area, open in front and on the side, so that one could see everything in the interior from any point of view. The depth of the windows was only one foot, and platforms were built and cars placed upon them. This arrangement allowed four cars to be exhibited individually, two in one front and two in the other. Neatly arranged behind on the floor was a collection of other cars. As one stood in the street, whether on the far side or not, he first saw the car in the window, vividly set off, and then upon closer inspection saw the background of cars in the salesroom. The lighting apparatus used in the windows was the trough reflector containing twenty-four 16-cp lamps and ordinary five-lamp clusters, with a porcelain shade in the salesroom; six clusters were used. But unless one stooped down they were not visible to the eye. Ordinary window shades were drawn down far enough to conceal the lamps and yet did not interfere with the view of the cars. Being on a busy thoroughfare it was good advertising and with certain changes never becomes dull.

Central Station Advertising in Binghamton, N. Y.

The Binghamton (N. Y.) Light, Heat & Power Company, a description of whose system was published in a recent issue, is a firm believer in advertising. A unique plan is to utilize its space in the local newspapers for the benefit of both itself and the customer. The electric light company supplies all the newspaper offices in the city with electricity for lamps and motors and accepts as payment a half-page in each issue of the paper. The space is used to boom a customer's business, an incidental mention being made of the fact that the customer uses the energy of the company for lamps and motors. The space is also used as an inducement to a prospective customer and at other times to a customer who will increase his energy consumption a specified amount or use his equipment in some way to the company's advantage. Reproductions of a few of these advertisements which serve to kill two birds with one stone, are shown herewith. Each of these occupies a half page, the reading matter being centered in the half page with a border and plenty of white space around it to attract attention.

Yesterday, when the thermometer was registering in the close proximity of 90° in the shade, reminded Mr. E. D. Vosbury how a few years ago, on Saturday evening he and his salespeople were compelled to go outside, into the street when they wished to get a good breath of air.

That was when Mr. Vosbury's Jewelry Store at 37 Court St. was lighted by other means than ELECTRICITY. He states that this one of the many features about ELECTRICITY that makes it so much more desirable than other illuminates.

BINGHAMTON LIGHT, HEAT, AND POWER CO.

¶ There are smokers in this town who think it absolutely necessary that they go to New York City for their cigars.
¶ Guess they don't know that Earl D. Ostrom, at 69 1-2 Court Street, has in stock at all times the very highest grades of cigars and cigarettes.
¶ At the present time he is showing in his window 57 different brands of the finest kind of nickle cigars.
¶ These things prove his progressiveness, but what makes it a certainty is that he uses our ELECTRICS for illumination.

BINGHAMTON LIGHT, HEAT & POWER CO.

WOULD YOU pay two dollars for an article you could buy for one?

Would you pay two cents for an article you buy for one?

The A & P. Tea Co., 64 Court Street, have an interesting proposition for people who save. It covers many articles including teas, coffees, spices and other groceries.

The A. & P. Tea Co., are extensive users of ELECTRICITY for illumination and for power. They use ELECTRICITY in every prominent city in the United States.

Binghamton Light, Heat and Power Co.

In pushing for sign and window lighting business, the company has found that photographs of customers' installations are very effective in attracting attention. Typewritten letters are sent to prospective users of electricity for this purpose and to the letter is attached a photograph of an attractive sign installation in the city. A return postal card is also enclosed on which is a photograph of some different electric signs. The working of the letter is particularly appropriate and to the

point, as the following example will show: "If you should hire a man to hand out cards with your name on them to the crowds that pass your door, you would perhaps secure a few new customers. But this man, no matter how hard he may work, can only reach a few of the many people who pass within sight of your establishment. The cheapest and surest way to catch the eye of everyone, near or far, and let them know where you are, is to use an electric sign. Many methods of advertising have been tried of late, but none seems to have grown as rapidly as the use of electric signs. By returning the enclosed card you can have an expert from this company call on you to explain anything to you that you may wish to know."

Three letters of like purport are sent at proper intervals, and the last is followed by a solicitor, whose way being thus paved usually finds the customer in a receptive mood.

Organization and Conduct of a New Business Department.

Among the papers submitted for the Co-operative Electrical Development Association prize, which was awarded at the last National Electric Light Association convention, was one by Mr. R. Borlase Matthews, which was very complete. Besides many suggestions which appeared in the prize papers which have appeared in these columns, Mr. Matthews' paper contains a number of specific suggestions on the conduct of a new business department which do not seem to have been exactly covered by the other papers. Some of these suggestions are therefore given here:

When the general scheme of the "system" to be adopted has been worked out, a general instruction book should be prepared. Such a book should be of the loose leaf form so that fresh instructions can be added in their correct place from time to time, as the system develops in its details.

It is advisable to maintain duplicate copies of this book—one for the use of employees, and the other for the manager's reference. A book of this description will prove of great value when a new employee is engaged and will generally assist in the smooth operation of the system.

The first thing that should be done in the actual work of the department is the compilation of a card index of existing customers, as it is essential that accurate information should be on hand ready for the time when the question of an increase in the lighting or power load has to be considered, and also to satisfy the queries usually put by a prospective customer as to what his neighbor is doing. This index should be arranged in alphabetical order of the streets of the city in which the building is located, and not according to the initial letter of the customer's name, or the number that has been allotted to him, since from the point of view of the supply of current, the building is the permanent feature and the occupant merely temporary. On the same card should be placed the customer's rotation number, and a note as to his connection in equivalent 16-cp lamps and in horsepower of motors installed.

The cards should be distinctly marked by a rubber stamp, say, with a broad red band across the center, so that they may be readily noted when placed with cards containing names of those who are not customers.

In the vertical index file, under the customer's rotation number, a form should be kept containing information similar to that sent into the Fire Underwriters' Association when their certificate of inspection is requested. A note should also be made on this form concerning any special application of electric current with any interesting data thereon. The next step is to verify this information by actually visiting the premises of the customer. While it is advisable to get the last mentioned particulars together as early as possible, it is, of course, more important, as soon as the card index of customers is completed, to make a similar index of all buildings and their occupants, within reach of existing service wires. To aid in getting this information together, maps of the distribution system should be prepared, having the primary and secondary lines indicated upon them in different colors.

This list completed, the remaining buildings in the city must be listed in the same way. In both lists the form of illumination employed, with details as to the number of gas jets, mantel burners, average monthly bills, the name of the owner of the building, etc., should be carefully noted.

With the collection of the above mentioned information, of course, commences the real soliciting. The way should be prepared as far as possible by suitable advertising matter, and the day before a call is made, a postal card should be sent making mention of the fact, thus paving the way for a favorable reception.

In residence canvassing it is well to endeavor to at least arrange to be allowed to present an estimate on wiring the house. The estimate should be prepared in two ways—one with the wiring done in the way that best suits the convenience of the householder, and the other in such a manner that the figure is cut as much as possible, by omitting all lamps but those which are absolutely necessary, and also leaving out as many wall switches as possible—thus giving an idea of the minimum price the work could be done for; the lower figure also shows up the difference between necessity and convenience, and puts in a somewhat better light, what at first appears to the average householder to be a very high figure. Chandeliers and other fixtures should always be figured upon as extras, as taste varies so much in the selection of these fittings, and their price added to the cost of wiring, makes the latter appear excessive.

A standard form should be prepared for use in getting the wiring data together, to ensure that nothing is omitted, and also so as to see that if the work is bid upon by more than one contractor, they base their estimates on the same specification.

As a rule it will be found best that the solicitor should not make an estimate at the time of the calling, though it is well that he should be able at times to give an approximate figure, making it quite clear to the prospective customer that this is so, and at the same time making mention that an accurate figure will be presented in the course of a few days' time.

Amongst the information the solicitor has at his disposal should be data as to the average bills of customers, their energy consumption per 16-cp lamp connected. The cost of lighting various size lamps per hour, and the cost per hour of operating various heating and cooking devices.

In canvassing stores the data as to the average, the maximum and the minimum consumption per lamp connected, are very valuable, since in the case of any proposed lighting scheme, the monthly bill can be fairly accurately estimated for stores doing the same class of business.

The general policy that should be adopted in soliciting is to see that the customer gets what will be most economical and serviceable, as it pays best in the end, though the load is not as great as it might be, for it means the obtaining of a satfied customer, which is a valuable asset since it implies a long continuance of business.

If the solicitor has with him illustrations of some of the principle components employed in house wiring, it will aid much in his explanation of such things as the difference between side brackets and drop lamps, between flush and wall switches, etc.

The installation of a motor, say, on a sixty-day trial, is almost invariably a safe risk to undertake. Under these conditions the best method of installation must be insisted upon and every care expended to insure the most economical results, by taking every advantage of the flexibility of a motor drive, and the possibility of cutting out all unnecessary line shafting, for the greater the economy effected, the sooner is the owner convinced of the good value of central station power.

Here, again, data as to the current consumption of other customers are of great importance. This should be tabulated in a similar way to that employed by Mr. E. W. Lloyd in his report to the N. E. L. A. in 1905, on purchased electric power in factories. In this report the following headings are used:

(1) Kilowatts per month, (2) Connected load in hp, (3) Individual or group drive, (4) Number of motors (5) Percentage of average load to connected motor load. The report referred to, is in itself of great assistance, and very useful in backing up local data.

Prospective power customers always wish to know what it is going to cost them per month to run a particular motor, and usually multiply the rated horse-power of the motor by the rate charged for energy, which is naturally an excessive figure. The tables mentioned above indicate that the average load on a motor rarely exceeds four-tenths of the rated load, and more usually is in the neighborhood of one-third that load.

A modified commission scale should be open to employees other than the solicitors, to encourage them in persuading their acquaintances to become customers. At the same time, it should be clearly pointed out that when someone is interested in this way, assistance should be sought to close the deal.

As an encouragement to employees to put forth their best efforts, a list of new customers should be posted up each month in the office together with the name of the man who obtained the new business, recognition of this sort generally being much appreciated.

Another commission scale should be prepared for wiring contractors, with the commission payable preferably one month after the installation has been in use.

A reduction of rates will not increase business as much as systematic canvassing does, provided that the existing rates are not excessive. The reason that many people do not wire their houses, is chiefly on account of the fear they have that the cost of so doing will be out of proportion to the advantages derived, hence the importance of dispelling any illusions that they may have on this point as soon as possible. The majority do not even ask what the rate is, though they often want an estimate of the probable monthly bill. They do not understand the rates as a rule, and knowing that the prices are the same to everyone, are satisfied that if their neighbors use it, the charge must be all right, so that to them it is all a question of installation cost.

Among other schemes worthy of consideration in getting electricity into a house is to make arrangements to install an electric flat iron, a sewing machine motor, or a fan. In connection with the reduction of the cost of wiring to as low a point as possible, the following plan will doubtless prove of interest A board is prepared, about 4 ft. long by 10 in. wide, on which is mounted a standard cutout and fuse box, a meter, a socket for a portable lamp, a thumb switch and a socket for the flat iron or motor leads. Such a board can be constructed very cheaply, and can quickly and easily be installed in a vertical position at the side of a window, the latter usually forming a convenient place of entrance for the service wire. The cost is less than that of wiring in the usual way, and if it is desired to remove the installment at any time it has not depreciated in value.

In one city alone about two hundred sewing machine motors have been installed in this way. The users largely consist of people working for neighboring factories, who prefer to purchase a motor and work at home rather than in the factory.

Flatirons at Massillon, O.

The Massillon Light, Heat and Power Company in Ohio about a year ago built a 10,000-volt, single-phase line to Canal Fulton, Ohio, to supply that town with electric light. Canal Fulton has a population of about 1,200. When the houses in the town were being wired the company gave with each job of wiring one electric flat iron. While this may have taken a little off the profits of the wiring job, it was undoubtedly a good investment, as it got flatirons into use very rapidly in the town.

Ornamental Lamp-Posts and Special Lighting on St. Paul Business Streets.

A movement was begun some months ago among the business men of St. Paul to accomplish the better lighting of some of the prominent business streets. As a result, Sixth Street, one of the principal business thoroughfares, is now lighted by special ornamental lamp-posts and the merchants on other streets are beginning to take up the matter. At this writing 65 ornamental lamp-posts of the designs shown in Fig. 1 are installed on Sixth and Seventh Streets. Fifty-four more posts are under contract, so that there will soon be a total of 119 such posts. This

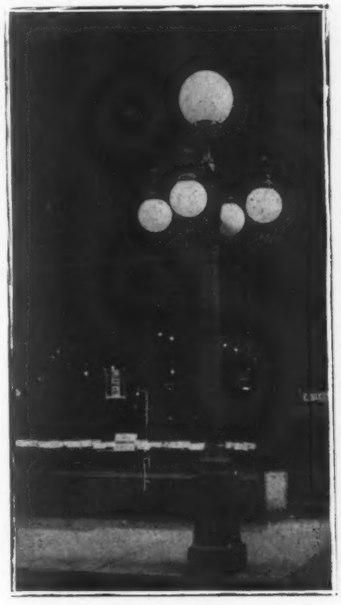


FIG. 1.—THE ST. PAUL LAMP POST.

general movement for the better lighting of the business streets of St. Paul is the result of the public spirit of St. Paul business men combined with some hard work done by the commercial department of the St. Paul Gas Light Company, of which H. J. Gille is manager. This company furnishes both gas and electric lighting service in St. Paul and has the contracts for maintaining and electrically lighting these posts.

The co-operation of the merchants necessary to put through a lighting scheme of this kind on a street was accomplished by means of improvement associations. There are three of these improvement associations in St. Paul and one more has just been organized. The plan so far followed has been to call a meeting of the property owners and tenants on a street to form an improvement association. At this meeting officers are elected, and committees appointed, consisting of four men in each block, two on each side of the street. These committees are for the purpose of getting all the tenants and property owners in their respective blocks to subscribe to the scheme. The property owners subscribe the money to buy the posts; the tenants pay for the lighting. The improvement association contracts with the foundry for the posts and with the St. Paul Gas Light Company for the erection of the posts, glassware, wiring, lamps, etc. The St. Paul Gas Light Company collects the money for the association and credits it to the association's account. Twenty per cent more is collected than the actual cost of lighting per front foot in order to provide a contingent fund to take care of unusual repairs or accounts which cannot be collected. This contingent fund, under the contract, is to be rebated pro rata to the subscribers at the end of each year.

The foundry work on the first lot of posts amounted to $55 each. The cost of installation was $45, making the total cost

per post $100. The post has at the top an opaline or very light opal globe 20 in. in diameter, in which is one 50-cp incandescent lamp surrounded by five 10-cp lamps. The globes, hanging pendant on the four arms of the post, each have

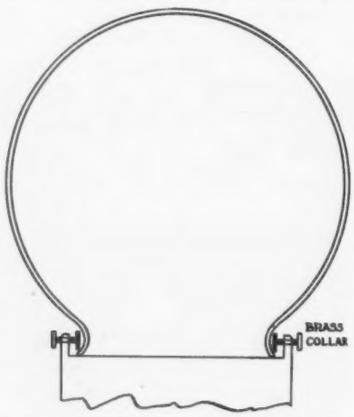


FIG. 2.—METHOD OF FASTENING GLOBE.

four 10-cp lamps and are of 12-in. diameter. The present watt consumption per post is 811, using common incandescent lamps. It is probable that large, high-efficiency lamps will be substituted for the clusters of small lamps when high-efficiency lamps are more common on the market. The 50-cp lamp for the top globe is on a separate circuit from the other lamps. The 50-cp lamp is burned all night. The other lamps are turned off at midnight. The lamps are turned on and off by the company's patrolman. The two circuits are controlled by snap key switches, the keyholes being in the base of the post.

In order to provide for the heavy wind pressure against the 20-in. globe on the top of the post, a brass collar is used around the neck of the globe to distribute the pressure of the thumbscrews with which the globe is held. A sketch showing this arrangement is given in Fig. 2. The wiring to the Benjamin cluster inside of the globe is brought up through a pipe and the cluster is screwed on to the pipe. Drainage is provided for any water caught in the top globe-holder. The

FIG. 3.—ARTISTIC LIGHTING ON A ST. PAUL STREET.

globe-holders are of cast iron. There is a brass collar on the 12-in. globes, hung pendant on the arms. Wires are brought up inside the post in "Circular Loom." Connection to the underground mains along the street is made through lead-covered cable buried directly in concrete. The underground mains along the street are in the old-fashioned Edison tube conduit. The inside of the post is filled with concrete up to the level of the door in the bottom.

The cost of maintenance and lighting is $101 per post per year. The 50-cp lamp on the top is turned on 4,000 hours per year and the other lamps 2,000 hours per year. The post is 14 ft. high over all and extends 4 ft. below the sidewalk. It is all one casting, except the arms at the tops, which are bolted on. The arms are 18⅝ in. long from the center of the post to the center of the lamp cluster. The base is 16 in. square by 30 in. high. Below the base is a 6-in. square pipe. These posts are placed 100 ft. apart, 8 to the block, 4 on each side of the street and opposite each other, as shown in the general view looking up Sixth Street, Fig. 3. The St. Paul Gas Light Company's offices are seen on the nearest right-hand corner. The blocks are 300 ft. long. Since the cost per year per post is $101, the cost per block is $808, which, divided by the 600 front feet of property on the block, makes the expense $1.35 per front foot per year. Collections are made monthly. The rate is such that the company receives a gross revenue of about 5 cts. per kw-hour. On the 119 posts already installed, only about 5 per cent of the frontage does not subscribe to the maintenance of the lighting. This is mostly property forming part of estates and those responsible for the property are not at liberty to spend any money not absolutely necessary. As said before, 119 posts are already in and under contract. It is expected to have 167 posts in use by May 1, and there is a possibility of 50 more, making 217, by July 1.

This uniform system of lighting adds much to the appearance of the streets on which it has been placed without detracting from the window displays and signs, as would some of the glaring attempts at street lighting which have been made in some cities. It would be even more pleasing were dense opal or sand blasted globes used which would not show the lamp filaments through the globe. The post lighting when started on Sixth Street, December 18, 1906, was the cause of a three-days' carnival, which was quite an event in St. Paul.

Development of the Brooklyn Edison System.

The new business of the New York Edison Company during the past year was the largest on record, reaching 1,000,000 equivalent of 16 cp. The Brooklyn Edison system has shown an equally large record, relatively, for the same period. During the twelve months of 1906 its new business figures are about equal to one-quarter of the total load connected to the system on January 1, 1906, that then representing the labor and development of seventeen years. The new business secured in 1906 was four times the average increase of business for the seventeen previous years of the company's existence. The net increase in connected load added to the Brooklyn Edison system last year is expressed as the equivalent of 250,000 lamps of 16 cp. The total load connected to the system now exceeds 1,175,000 of such equivalents. There are only four other electric lighting companies in the world whose total connected load will reach the one million mark, namely, the Edison systems of New York, Chicago, Philadelphia and Boston.

It is interesting to note that one-half of the increase for the year was in the motor business of the company. A large number of manufacturing plants during the year abandoned their own isolated plants in favor of the service of the company. Among such establishments may be mentioned the Lidgerwood Manufacturing Company, with 520 hp in motors, 100 arc lamps and 1,000 incandescents. Other concerns are the F. Wesel Manufacturing Company, with 425 hp and 700 incandescent lamps; Henry Batterman, dry goods store, with an installation of 1,000 incandescent lamps, 500 arcs and 65 hp in motors; Philip H. Gill & Co., with 110 hp in motors. During the same year the Bush Terminal Company had added 900

hp in motors to its installation and has also extended the period of its contract with the Edison Company. Some few others of the larger concerns who have become Edison customers, or have largely increased their installations, are included in a list which represents about 2,000 hp in motors and 5,000 lamps.

To take care of the large volume of new business indicated in the foregoing and to provide adequately for the future, the company is now engaged in making some very extensive additions to its generating and distributing equipment. The generating station of the company at the foot of Gold Street has been entirely remodeled. An Allis-Chalmers horizontal steam turbine of 8,000 kw capacity and a Westinghouse turbine of 11,000 kw capacity have been installed at this station. Another turbine has been ordered and it is the intention to install more turbines in this station from time to time as the demands of the system may require them, until the ultimate capacity of the new station, 85,000 kw, is reached.

Other improvements already made or planned at Gold Street are as follows: An entirely new condensing water system has been constructed consisting of concrete intake and overflow tunnels and connections to these made ready for the installation of condensing apparatus of the turbines. Two of these units are now connected. A 75-ton traveling crane and runway has been installed. On the water front an entirely new dock and bulkhead have been constructed, and on this dock a complete system for the rapid and efficient handling of coal and ashes is being installed.

During the year just begun the old building back of the present station and extending through to John Street will be torn down and foundation laid for a new boiler house, which will contain eventually 52,000 boiler hp. It is expected to install sixteen of the ultimate eighty boilers at first. A highly modern and finely appointed sub-station has also been erected at No. 580 Carroll Street and another smaller one at the foot of Dikeman Street.

The company has also during the year outgrown its office capacity and to provide adequate accommodations for its largely increased office force, has replaced a large machine shop in the Pearl Street building with offices, has hired a big floor fronting on Adams Street and connected to it the main structures by a runway, and is now engaged in the construction at Pearl Street of a floor on a level with the street and a mezzanine floor between that and the present office floor, all of which space will be utilized for offices. During the year in the way of extensions, the company has laid 30 miles of underground mains.

A feature of the Edison year which is worth noting as indicative of modern methods in the intelligent handling of large numbers of employes is the interest the company has taken in its working force and the plans that have been put into effect to instruct and entertain them. The Edison Club has been formed and the company has hired for its use ample quarters in the Johnston Building. These have been equipped with billiards, pool and card tables and a reference library of current literature, both lay and technical. A large reading room has been fitted up in which are held the frequent gatherings of the various organizations connected with the different departments of the company. The company has also arranged for its employes a course in elementary and applied electricity, having secured the services of a well-known professor who lectures one evening a week at the club rooms, the average attendance at this class being over 150. There is no expense to the employe connected with any of these privileges.

To provide for the large capital expenditures previously outlined the capital stock of the Kings County Electric Light & Power Company, which owns and finances the Edison Company, was increased from $5,000,000 to $10,000,000; $3,200,000 of the additional capital was issued March 1, 1906, and the remaining $1,800,000 will be issued March 1, 1907. With this issue the combined securities of the Kings County and Edison Companies all listed on the New York Stock Exchange, will amount to $22,000,000. Dividends have been continued on the stock at the rate of 8 per cent per annum.

Display Lighting at Lincoln, Neb.

In the ELECTRICAL WORLD of November 3, 1906, some account was given of the remarkable development in sign and outline lighting of buildings at Lincoln, Neb., by the Lincoln Gas & Electric Light Company. This was later supplemented by a paper presented by Mr. Homer Honeywell, general manager of that company, to the Northwestern Electrical Association Convention at Chicago, and published in abstract in the ELECTRICAL WORLD, of February 2, 1907. The accompanying Figs., 1, 2 and 3, are night photographs taken on the streets of Lincoln, showing some of this outline lighting as well as some show window

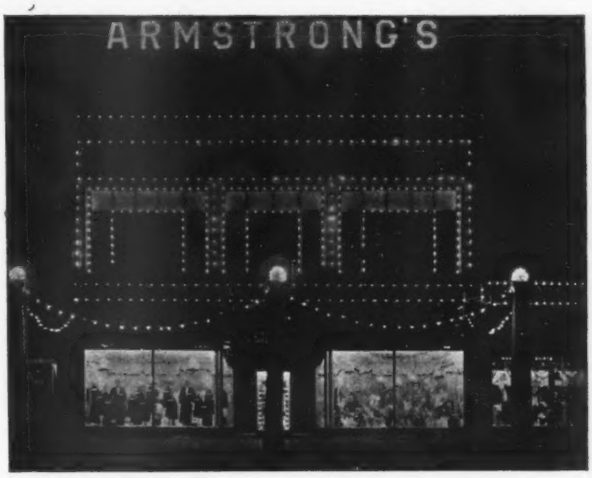


FIG. 1.—OUTLINE LIGHTING.

FIG. 2.—OUTLINE AND WINDOW LIGHTING.

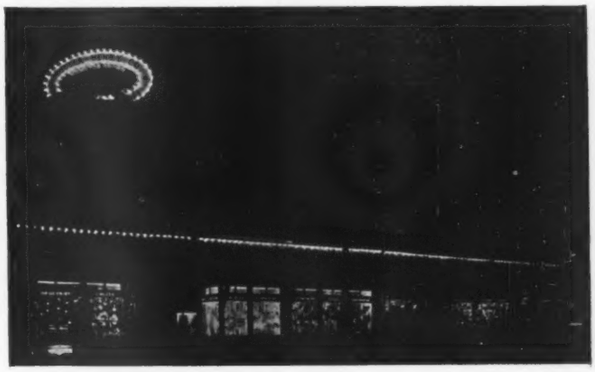


FIG. 3.—WINDOW SIGN LIGHTING.

lighting. At the time Mr. Honeywell's paper was written there were 8,500 lamps of 4 cp on a flat rate for sign, outline, sidewalk and showcase lighting; 900 16-cp lamps were used in window lighting. The remarkable effect of this business is shown by the fact that the increase in peak load on the station last year as compared with the year previous was only 23 per cent, while the sales increased 60 per cent.

Rates for Electrical Energy.

By P. T. Hartwell.

When any question of rates comes up there are usually two important considerations, one the question of long hour discounts irrespective of the size of the customer; the second, the question of wholesale and retail. Curiously enough, whenever the subject is presented to a layman, he will at first sight understand the reasonableness of the wholesale and retail because he is accustomed to it; but the question of long hour and short hour rates needs explanation.

The minute the layman has investigated the subject he is ready to admit the reasonableness and propriety of long-hour discounts, but is inclined to question the legality of making a lower rate to the large customer than to the small one. One reason for this is that the distinction is not always clearly brought out, that there is a proper distinction as between wholesale and retail, but that the distinction on account of size merely is not a proper one for a public service corporation.

Wholesale means that a large quantity is sold at once, without division. Retail means that the produce is cut up into small packages, and the expense of the division and distribution warrants the higher price.

The Interstate Commerce Commission and the courts have time and again justified the difference between broken packages and carload lots. On the other hand, the courts and the commissions have on the whole uniformly decided that a customer who shipped fifty separate small packages, or a thousand such in as many shipments, was not entitled to any better rate than the small consumer or user, or shipper. This has been brought out recently by a case of electric distribution. A large electric company has a transmission line running to the suburbs. At one point on the transmission line distribution lines branch out which supply a number of small customers. The average price for electricity to these small customers is made about 14 cents a unit.

On the other side of the transmission line a town buys the energy at wholesale and distributes it to its own people. The town buys the energy at wholesale, at an average price of about 4 cents or 5 cents a unit, and sells it again in the town at an average price of about 14 cents, or substantially the same as the price charged by the company itself in the adjoining town.

The cost of distribution to the town that buys at wholesale and sells again is approximately 10 cents, including the fixed charges on the distribution system. The costs of distribution in each town are substantially the same, so that the electric company makes substantially the same profit on selling wholesale at, say, 5 cents, or selling retail at 14 cents.

At the same point where these two distribution systems branch off from the transmission line, there is a large factory which also buys electricity at wholesale from the transmission line, at an average price of about 5 cents.

By comparing these three cases, first where the company retails, second where the company wholesales the energy to the town to be retailed and third, where the company wholesales the energy for direct use at the factory, it is seen that nothing except wholesale discount based on a large delivery at a single point will give equitable results.

The case is also interesting as showing that a wholesale price for retail distribution would be unjust. If all the people in the town where the company now retails should club together and make a single contract for energy, the company could not afford to make any wholesale price unless they delivered all the energy at one point and let the purchaser stand the expense of distribution.

Letter to the Editors.

Illuminating Engineering.

To the Editors of Electrical World:

Sirs:—The article in your first issue of February, describing the illumination of the new capitol building at Harrisburg, Pa., carries with it an instructive lesson as to the value of the newest specialist in the electrical field—the illuminating engineer. In the Harrisburg installation almost every tenet of the new art of illuminating engineering appears to have been violated, and the enormously expensive fixtures seem to have been designed without any consideration whatever to their primary functions of settings for the sources of illumination. Without any doubt the illuminating engineer working in collaboration with the architect and fixture designer could have kept the expense for fixtures to a small part of the sum of $2,000,000, which they actually cost, and produced settings far more artistic in that they would have borne some direct relation to their primary purpose as adjuncts to illumination. Paintings that canont be viewed owing to the disposition of the light sources, the interposition of brilliant sources in the line of vision; massive supports—in some cases weighing tons—to carry a few pounds weight of lamps; sources actually obscured by fixture filagree work and shades—these are but a few of faults that render the Harrisburg installation a monument of illumination folly. Indeed it would almost seem that the primary purpose in view was not provision for illumination, but the design of fixtures that would cost the maximum possible sum of money to execute. The attempted magnificence with its failure to meet the utilitarian object of its being, reminds one of the expensive freaks of newly made millionaires, who are apt to think that with $1,000 they can secure an artistic effect—regardless of the subject—ten times greater than with an expenditure of $100.

Philadelphia, Pa. James T. Roberts.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

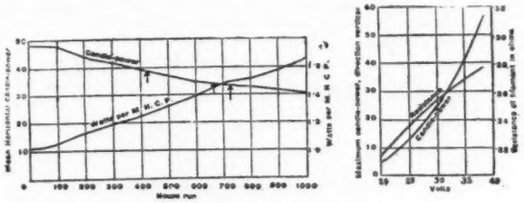
Commutator Connection.—The connection between the armature conductor and the commutator segment may be made by soldering the conductor directly into a slot milled in the segment or by inletting a connecting lug into the segment. A new method devised by Dawson consists in making the projecting lug out of sheet metal the full size of the commutator segment. This thin sheet can be stamped out of a required shape, and the V to receive the armature conductor is then formed by bending the projecting lug back on itself. These plates are inserted beside the commutator segments and clamped up with the same. No more copper is needed in the commutator than heretofore, and the usual soldered joint between segment and lug is replaced by the large surface connection between the connecting strip and the adjacent segment.—Lond. *Elec. Eng.*, February 1.

Lamps and Lighting.

New Incandescent Lamps.—An account of some remarks made by Paterson of the (British) National Physical Laboratory in the discussion of Swinburne's recent paper. The results are tabulated as follows:

Lamp.	Volts.		Initial cp.	Initial consumption.	Total watts.	Per cent cp drop after 1,000 hrs.
Nernst	200	25	"M. Hem.-Cp."	2.2	56	70
Graphitized carbon	100	16	M. Hor. "	2.8	45	20
Tantalum	110	23	" "	1.9	44	35
Zircon (early lamp)	37	48	" "	1.0	50	37
Osram	100	25	" "	1.4	35	—
Ordinary carbon	100	16	" "	3.6	57	20
Ordinary carbon	200	16	" "	4.3	69	20

The Nernst lamp, although it had a large drop in cp with age, is the only one of the new lamps which will run on 200 volts. The zirconium lamp has been much improved lately. The total watts column read in conjunction with the candle-powers shows that the power taken by the various lamps is nearly of the same order of magnitude. The cp of the metal filament lamp only varies as the 3.5 power of the voltage, as against the fifth or sixth power of the carbon filament lamp. Figs. 1 and 2 give the results of tests of six 37-volt 48-cp zirconium lamps,



(Arrow-heads denote broken filaments.)

FIGS. 1 AND 2.—RESULTS OF LAMP TESTS.

Fig. 1 giving the variation of cp and consumption during a run of 500 hours, and Fig. 2 giving the maximum cp in vertical direction and the resistance of the filament in ohms as function of the voltage.—Lond. *Elec. Rev.*, February 1.

Incandescent Lamps.—PATERSON.—The second part of his (British) Inst. Elec. Eng. paper on investigations on light standards and the present condition of the high-voltage incandescent lamp. This installment deals with incandescent-lamp testing and draws attention to the great variation in cp and efficiency of English lamps, as compared with results of tests of American lamps. Several "target diagrams" from tests of English and American lamps are given which show that if the American upper and lower cp limits be applied to the English lamp tested, about 45 per cent of them would be rejected, while if they are applied on the assumption that the average cp is to be 16, only 35 per cent of the lamps would pass the test. Lamps tested for life in England are usually run at their rated voltage until they either break down or their cp has dropped to 80 per cent of its initial value. This method, however, is open to serious objections. A lamp can only be guaranteed to have a life of given length when the filament has run at some definite temperature (see Fig. 3). This can be

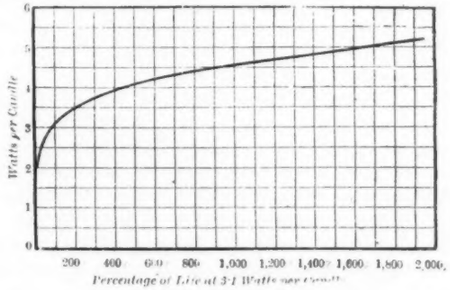


FIG. 3.—LIFE CURVE OF LAMPS.

adjusted to a near degree of accuracy in carbon-filament lamps by running them at some known watts per candle. If the life of a batch of lamps has been specified to be a certain length at 3.1 watts per candle then it will only be necessary to test, say, 5 lamps at this consumption and take the average of the five. If, however, the run should be made at the marked voltage instead of at the specified watts per candle it would be necessary to test 5 or 6 times the number of lamps in order that there might be a reasonable probability that the life deduced from the mean should be within 5 per cent of the true value. A number of diagrams from actual tests show that when run at a definite initial consumption the cp of individual lamps of a given make will keep very close together throughout their life. This leads to the conclusion that five lamps being taken from each consignment, and being run on life test at definite initial watts per candle, in six cases out of nine the probable error is under 1 per cent, while the maximum probable error is 1.3 per cent; so that in practically all the tests made in this way results may be relied upon to within 2 per cent. The system adopted at the Electrical Testing Laboratories of New York is to adjust the voltage initially on each lamp so that it is burning at its standard candle-power. The method insures that the 16-candle lamp, for instance, has the advantage of the full amount of drop from 16 to 12.8 candles before its useful life is considered at an end. The disadvantage is that on the life test it may be running at slightly above or below the correct watts per candle. The author prefers the method adopted by the (Brit.) Engineering Standards Committee of having the watts per candle rigorously correct. Lamps should then be chosen for the life test which are nearest to the standard candle-power. In practice, however, the difference between the two methods amounts to very little. Fig. 3 shows the connection between consumption and life for one make (British Thomson-Houston Company). The ordinates represent watts per candle, while the abscissæ represent the percentage variation in the useful life of the lamps when run at different watts per candle. The life at 3.1 watts per candle is assumed as 100 per cent and the curve shows for instance that the life is twice as long, or 9 times as long when the lamp is run at 3.5 or 4.5 watts per candle, respectively.—Lond. *Elec.*, February 1.

Discussion.—An account of the discussion of Paterson's paper on photometry and carbon filaments. Fleming had pointed out the variability of flame standards four years ago. It was left to the electricians to discover this, for the gas people always measured one flame against another, and they varied together. Large-bulb incandescent lamps are the best as standards. The falling off in light is due to deposit on the glass, and there is less obscuration from this cause with a large bulb. It is important to solder the leads. Plaster caps and contacts introduce a possibility of error. It is also important to run the standard lamp four or five days, and make sure that the curve is flat before standardizing it. It can be used for about 200 measurements with less than 1 per cent variation. Robertson wanted unknown lamps to be excluded, and therefore welcomed the new specification. Russell considered it inequitable to judge a lamp by its mean horizontal cp. The proper thing is the mean spherical cp. A reduction factor can be obtained by measuring in two directions, thus: Ratio of mean spherical cp to mean horizontal cp $= 0.785 + 0.11 \frac{I_v}{I_h}$. Here I_v is the vertical candle power and I_h the mean horizontal. Wild pointed out that height of ceiling (and consequent draught) was another influence to be reckoned with in the case of flame standards. Then he objected to rating by mean horizontal cp; it would be better to rate by maximum horizontal cp than by the mean. But the best thing is to use mean spherical cp, otherwise a difference in shape of filament might alter the reduction factor from .8 to .9.—Lond. *Elec. Times*, January 31.

Mean Candle Power.—HERZOG AND FELDMANN.—A mathematical paper illustrated by diagrams. The gist of the discussion is that neither the mean spherical nor the mean hemispherical cp is sufficient to answer all questions coming up in illumination practice but that it is necessary to know the whole "photometric body," that is the distribution of the cp in all directions of space around the source of light. Since the lower

mean hemispherical cp cannot give exhaustive information on the efficiency of a lamp, it is wrong to consider it alone as has been proposed in the standardization rules of the Association of German Elec. Eng.—*Elek. Zeit.*, January 31.

Power.

Efficiency of Heat Engines.—Hort.—A general review of the development of machines for changing heat into mechanical energy, with reference to the law of Carnot which states that the thermodynamical efficiency equals the difference of the upper and lower temperatures divided by the upper temperature of the working cycle. According to this law the ideal thermodynamic efficiency is independent of the special substance which is used for transferring heat. Further, in order to get as high an efficiency as possible it is necessary to make the upper temperature as high as possible and the lower temperature as low as possible. The way in which the latter rule has been followed indicates the historical development of the steam engine. Watt used low steam pressures up to about 3 atmospheres. In the middle of the 19th century steam pressures of six to seven atmospheres were used, while at present pressures of 10 to 12 or more atmospheres are employed. The gain obtained thereby gets less and less the higher the pressure and in general it is not advisable to go beyond 14 atmospheres with saturated steam, that is beyond 194° C. At the same time the endeavor was made to decrease the lower temperature of the working cycle by improving the condenser. To-day air-pumps are built which easily maintain a vacuum of 0.2 atmospheres corresponding to a temperature of 56° C. It would not be difficult to go further down, but such procedure would soon become uneconomical. Hirn was the first who tried in 1857 to increase the upper temperature by superheating, and this method has become very successful later on, after suitable lubricating oils had been found. The upper limit of temperature is about 400° C, but this temperature is hardly reached in practice. It has been found that besides the theoretical gain due to the increase of temperature a special property of superheated steam is of greatest importance, namely, its poor conductivity for heat. This results in the losses due to condensation in the cylinder becoming almost zero, the walls of the cylinder being practically impermeable for heat, and for this purpose the temperature of 360° C. of steam are sufficient. The author then reviews in a general outline the efficiency of reciprocating engines, of steam turbines, gas engines and oil and gasoline engines. The recognition of the fact that the degree of compression has an essential influence on the utilization of fuel has led to the Diesel engine. Diesel did not follow the former method of sucking in an explosible mixture but introduced the fuel only after completed compression of the sucked-in air, thereby starting simultaneously the ignition. In this way pressures up to 35 atmospheres become possible. The author considers the Diesel engine as the most perfect heat-engine of modern times, and believes that the application of the principle of Diesel to gas engines will greatly improve the thermal efficiency of the latter. He finally briefly discusses the proposition by Schreber of a triple-vapor engine, operating in the highest stage with aniline, in the middle stage with water and in the lowest stage with ethyl amine. Finally he refers to the idea of using powdered coal instead of oil for the operation of a machine working according to the Diesel principle. Diesel has indeed made experiments in this direction.—*Phys. Zeit.*, January 15.

Electrically-Driven Rolling Mills.—Brown.—The first part of a long paper read before the Rugby Eng'ing Soc. The principal difficulty in applying electricity to the driving of rolling mills lies in the determination of the power required. Koettgen has made extensive determinations of the energy used to roll material out to various lengths. These results are given in Fig. 4. the abscissæ representing the number of times the length of the piece is increased during rolling, and the ordinates the foot-tons per ton required to effect this extension. The curves show the amount of work required by the different classes of steel, and it will be noted that there is considerable variation in steel of the same class. In order to determine from these curves the amount of energy to be expended on the material during each pass, there is evidently required a knowledge of the reduction of section, and, therefore, the increase of length effected during that pass. In other words, it is necessary to know the grading or calibration of the rolls. Considerable allowance must, of course, be made for friction, and in order to determine the actual horsepower to be supplied by the motor at any given instant, the inertia of the moving parts must also be taken into account. This presupposes a knowledge of the construction and dimensions of the rolls and gearing. In the

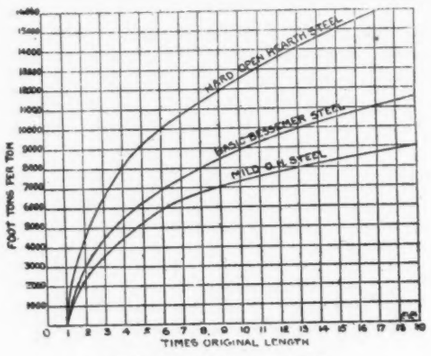


FIG. 4.—POWER CURVES.

case of two and three-high mills, the determination of the flywheel weight is an essential part of the problem, and one for the solution of which no general rule can be laid down. Such flywheels are generally of cast iron with a peripheral speed of 90 ft. to 100 ft. per second and their weight varies from about .16 to .08 tons per motor brake-horsepower. The larger figure applies to small sets of rolls driven by motors up to 100-150 hp, and the smaller figure to mills driven by motors with normal ratings up to 1,000 hp. The author then investigates the subject mathematically and describes actual installations with special reference to the Illgner system.—Lond. *Elec. Eng.*, Feb. 1.

Large Gas Power Plants in Italy.—A note stating that a company has been formed in Milan under the name Societa Anonima per l'Utilizzazione dei Combustibili Italiani. The largest banks and electric firms of Italy participate in the undertaking, like Banca Commerciale, Societa Edison, Societa Conti, Brioschi e Finzi and others. The company intends to utilize the peat and lignite deposits available in several parts of Italy by gasifying them at the spot in large gas engine central stations. The electrical energy is then to be transmitted. The Mond process is to be used so that it will be possible to recover all the nitrogen in form of ammonium sulphate, which byproduct alone is thought to cover the cost of operation. The first plant is to be erected in Toscana near Pontedera where the peat of the old Sea of Bientina is to be utilized. This first station will have a capacity of 2,000 hp and will be finished within 1907.—*Elek. Zeit.*, January 31.

Spanish Power Transmission.—A note on the transmission system installed by the Oerlikon Company for transmitting 3,900 kilovolt-amperes at 50,000 volts to the city of Sevilla in Spain from a water-fall at a distance of 128 kilometers. The plant contains three alternators generating three-phase currents at 5,000 volts with a frequency of 40, the capacity of each generator being 1,300 kilovolt-amperes with a power factor of 0.78. In order to avoid dangerous increases of voltage due to resonance the pole pieces have such a form that the voltage curve is sinusoidal. Six single-phase transformers raise the voltage from 5,000 to 30,000 volts. Since the transformers are connected three in star fashion, the voltage of the line is 52,000. At the sub-station of Ureva 7 transformers of the same capacity and of the same construction are provided.—*L'Ind. Elec.*, January 25.

Oil-Engine Tramway Plant.—An illustrated description of a small generating station supplying a portion of the West

Riding electric tramways. Two 310-hp Diesel engines are provided direct coupled to 500-volt generators. The starting of the engines is effected by means of compressed air and "the fuel consumption of the engines is 0.42 pounds of crude oil per b.hp at full load." Even at light load this fuel consumption does not materially increase.—Lond. *Elec. Rev.*, February 1.

Electric Power in Mines.—An illustrated description of the electric installation at the Bradford colliery near Manchester which is a typical present-day British mining plant. There are four generators, direct current being used for power purposes as well as for surface and underground lighting. For power purposes a voltage of 500 is used, for lighting 230 volts.—Lond. *Elec. Rev.*, February 1.

Electric Cranes.—HUNDT.—A fully illustrated description of electric cranes at the Bavarian Jubilee Exhibition in Nuremberg in 1906.—*Elek. Zeit.*, January 31.

Traction.

Regulations for Street Railways.—An account of the principal points in the new Prussian regulations for the construction and operation for street railways. Those regulations which refer to electric street railways are abstracted.—*Elek. Zeit.*, January 31.

Installations, Systems and Appliances.

Central Station Design and Operation.—HOLLIS.—An abstract of a paper read before the New Castle Section of the (British) Inst. Elec. Eng. The author first describes the complete unit system, whereby each engine and generator, having its own boilers and auxiliaries, is independent of all the other plant in the station. This involves a reduction in the working efficiency and an increase in the capital cost. He does not think that the single-unit system provides much increase in reliability, except when anything goes wrong with the boilers or steam piping. His idea is rather to have the steam range split up at several points by electrically-controlled valves operated from the switchboard, and which would ordinarily be open. In the rare event of a breakdown these valves could then be closed, isolating the faulty plant. He is strongly opposed to approximately constant-speed fans and pumps; the saving in consumption by having considerable speed control is worth the extra outlay, even if it involves putting in direct-current variable speed motors in a three-phase station. In connection with the earthing of the neutral point of star-connected alternators, it has been found that large earth currents often circulate between two alternators running in parallel. He considers these due to one machine having a third harmonic of greater value than the other; this is partly confirmed by oscillograph records which show the earth currents to be of triple frequency. The trouble can be overcome by inserting a reactance in place of the resistance in the earth circuit, as it will tend to damp down the high-frequency currents. The last point dealt with is an arrangement for safeguarding employees when cleaning high-tension switchboards. It consists of a number of wire swing-doors behind the whole length of the switchboard. To gain access to a panel for cleaning purposes a pair of the doors has to be unfastened and swung inwards until they meet the projecting slabs fixed between the panels of the switchboard. They thus prevent an unskilled workman from getting at any other panels. In the discussion which followed the paper opinions differed as to the advantages of the single unit system and the use of variable-speed motors, but the arrangement of swing doors behind the switchboard was considered a good one.—Lond. *Elec.*, February 1.

Electric Power Supply in London.—PEARSON.—In the first article of a serial on the various central stations in London the author deals with the Charing Cross, West End and City Electricity Supply Company. The lighting business of the company is of very considerable extent. The lighting load in the City District is principally a day load and falls off to almost a negligible quantity by 6 p. m., when the offices close for the day. It is, however, just at this time that the lighting load in the West End district comes on and the change from East to West naturally synchronizes with the migration of passengers from the City to the West End. If the lighting load alone had to be reckoned with the company's load factor would probably be considerably higher than that of the average central station, but it appears that in this case the connection of motors to the mains has had an adverse effect on the load factor. Newspaper printing requires a great deal of power from the mains, but their load factor is exceedingly poor. In one case a consumer runs his motors fully loaded on two separate occasions of one hour each per week. As a result the increase of 22.4 per cent to the motor connections during the last 12 months has lowered the load factor from 13.6 to 12.5 per cent. The principal generating station is situated at Bow. The largest sets are two three-phase generators of 4,000-kw, directly coupled to vertical engines. In addition there are four three-phase generators, directly coupled to horizontal engines, each developing 1,600 kw. Finally there are two small generators attached to vertical engines, each developing 800 kw. Thus the generating plant aggregates 16,000 kw. Three-phase currents are generated at 10,000 volts at a frequency of 50 periods per second. In the city district there are four sub-stations where the voltage is changed from 10,000-volt alternating current to 200-volt and 400-volt direct-current for the supply of a three-wire network. Both synchronous and induction-motor generators are installed at these substations, the motors being supplied directly at 10,000 volts. In the Western district there are also four substations, being supplied from the Bow generating station as well as from the Lambeth generating station. The writer does not think that cheaper rates for electric power would attract manufacturers to London. The rates for power are already low enough, but building restrictions are prohibitive and rates and taxes are high as are also prices of labor and raw material.—Lond. *Elec.*, February 1.

Electro-Chemistry and Batteries.

Storage Battery Improvements.—LYNDON.—A letter criticising some points in the recent paper of Cowper-Coles. He refutes some statements by the latter concerning the Bijur battery and strongly objects to the statement that the loss of pressure at high discharge rates of a storage battery is due to a change in the ratio between the external and internal resistance. The diminution in the voltage caused by the decrease of acid strength in the pores of the plate is entirely left out of consideration by Cowper-Coles. The latter's method of fixing the cut-off point is considered by the present writer to be a step in the right direction, but the procedure involves the knowledge that the most discharged part of the material in the cell is in the same condition as the average amount of material in the plate. Further, to assume a general curve for all types of cells would be a manifest absurdity, since the ratio between the cut-off voltage at high rates and at low rates is very largely dependent upon the ratio between the capacity of the negative and the positive plates, of which the author takes no account.—Lond. *Elec.*, February 1.

Units, Measurements and Instruments.

Flicker Photometers.—Dow.—The flicker type of photometer has recently come to the fore on account of its convenience for the comparison of sources of light of different colors. The author first describes the fundamental principles of the construction of the flicker photometers of Wood, Whitman and Wild. The advantage of flicker photometers lies in the fact that an unpractised observer is usually at once able to distinguish the point of disappearance of a flicker, while it requires a certain amount of practice to judge equality of illumination, or contrast, as must be done in an ordinary photometer. This is more especially the case when the lights differ in color. But there does not seem to be any gain in sensitiveness in flicker instruments, and a practised observer would probably get closer results with a good con-

trast photometer. The contrast element can, however, be introduced into the flicker photometer in the following way. The portion of the photometrical surfaces forming the field of view are of appreciable size, and hence that portion which is nearest to the lights compared is perceptibly lighter than that which is furthest away. For this reason we can usually see a faint flicker round the edge of the field of view when the center portion appears flickerless. By making the aperture somewhat larger than that usually employed this edge-flicker becomes distinctly noticeable, so that, at the position of balancing, the center of the field of view is flickerless, but a flicker of equal intensity is visible on either side. If the position of the photometer is now slightly disturbed from balance the center may still appear flickerless, but the slight flicker on one side of the field of view becomes weaker while the flicker on the other side becomes more violent. We have thus a double effect similar to that utilized in the contrast form of the Lummer-Brodhun photometer, and the author has found a distinct gain in sensitiveness thereby. A drawback to the use of flicker photometers is their fatiguing effect on the eye. The author objects to the statement that flicker photometers are independent of color and unaffected by the Purkinje effect, but he emphasizes that this is by no means a drawback but must be considered as a vindication of the flicker photometer. The Purkinje effect, for instance, merely means that as the illumination is weakened our perception of red light fades out more quickly than of the green, so that green lights tend to become more and more accentuated in comparison with red lights. Eventually we become red-blind and cannot detect red light at all. Now this effort may be noticeable under practical conditions—probably, for instance, distinctly noticeable in street lighting where the illumination of the pavement may fall as low as 0.005 candle-ft. What, therefore, would be the value of a photometer which, under these conditions, gave to red and green lights the same values as when the illumination was strong? In addition to this, the author's experiments confirm the result previously found—that for lights of different colors the reading of a flicker photometer depends appreciably on the angle subtended at the eye by the field of view. The size of the field of view is limited by certain practical restrictions, as the distance of the eye is limited by a telescope, and it does not seem likely that grave differences would be introduced in this way under the ordinary conditions of photometry. But when the two lamps compared give out light of practically pure colors the size of the orifice through which the illuminated surfaces in the photometer are observed seems to make a distinct difference in the results.

Nature of Orifice	White / White	Green / White	Red / White
No. 1	1·002	1·06	0·84
No. 2	1·002	1·03	0·86
No. 3.	1·006	0·92	0·93
No. 4.	1·003	0·97	0·95

FIG. 5.—RESULTS OF PHOTOMETER TESTS.

Some interesting results obtained by the actual tests of the Whitman photometer of the four different size orifices are given in Fig. 5.—Lond. *Elec.*, February 1.

Eddy-Current Testing Brake.—A description of an electric magnetic brake for absorbing and measuring the output of motors. It consists of two copper discs mounted on a bush which can be keyed to the spindle of the motor which is to be tested. Between these discs and acting as a floating central hub is an aluminum casting which carries the magnetizing coils, the external yoke rings and the graduated and balance levers. The coils are excited by direct current and produce a powerful multi-polar field in the gap in which the disc revolves. Eddy currents are generated and the output of the motor is thus expended in heating the copper discs. The strength of the induced currents, and therefore the brake horse-power absorbed depends upon the intensity of the magnetic field and this is controlled by means of a rheostat in the exciting circuit. The torque, resulting from the interconnection between the magnetic field and the induced currents in the discs, is balanced by a weighted lever flowing between stops. The brake is not adapted for prolonged tests at full load, but is useful for quickly measuring the efficiency at the end of such a test.—Lond. *Elec.*, February 1.

Compensating the Inertia of Selenium.—Korn.—E_1 E_2 (Fig. 6) are two equal batteries of accumulators in series, and Se_1

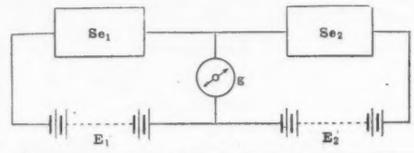


FIG. 6.—COMPENSATING THE INERTIA OF SELENIUM.

and Se_2 two selenium cells placed in series in the circuit. In the bridge abutting between the two batteries and the two cells a galvanometer, g, resembling those used in telephotography is arranged so that the cell, Se_2, is illuminated by a source of light in proportion to the deflections of the galvanometer. If the resistances of the two selenium cells are made the same in obscurity, the deflection of the galvanometer will be zero as long as Se_1 remains in obscurity. If Se_1 is illuminated a current will pass along the bridge, produce a deflection of the galvanometer, g, and illuminate the cell, Se_2. The author shows mathematically how to choose the constants of the apparatus so that a deflection of the galvanometer will become proportional to the intensity of light falling on the cell, Se_1, in spite of the inertia of the selenium—i. e., in spite of its property for retaining somewhat of the impressions of all preceding variations of light.—*Comptes Rendus*, December 3; *L'Industrie Elec.*, January 10; Lond. *Elec.*, January 25.

High Temperature Scales.—Holborn and Valentiner.—An account of an extended investigation of the temperature scale. The authors point out that our temperature scales are chiefly based on the indications of nitrogen gas thermometers and of thermocouples. But from their measurements they conclude that the former comparisons between the two thermometers were not as reliable as they had been considered. They think that they have now reached an agreement within one degree between the two methods. They have further made a very careful determination of the melting point of palladium, which is now one of their fixed points, 1575° C. Their redetermination of the melting point of platinum gave 1789° (the text says 1589°, but this is evidently a misprint)—that is nearly 80° higher than Harker's value of last year, which has been widely accepted. Further determinations will be made and for the present the Reichsanstalt itself (where the present investigation was made) will not make alterations in its official temperature scale.—*Ann. d. Phys.*, January; Lond. *Eng'ing*, February 1.

Transformer Testing.—Reid.—A paper read before the Dick-Kerr Eng'ing Soc. giving practical notes on transformer testing, especially insulation tests, resistances, copper losses and impedance, core losses, regulation, load curve and temperature test, and efficiency of transformers.—Lond. *Elec. Eng.*, February 1.

Telegraphy, Telephony and Signa's.

Compensating Microphone.—A full English translation of the new French or Italian compensating microphone noticed in the Digest some time ago. The characteristic feature is the increase of the effect by providing loose contacts both before and behind the diaphragm.—Lond. *Elec. Eng.*, February 1.

BOOK REVIEWS.

DIE ELEKTROLYSE GESCHMOLZENER SALZE. Dritter Teil: Elektromotorische Kräfte. By Richard Lorenz. Halle: Wilhelm Knapp. 322 pages, 75 illustrations. Price, 10 marks.

This is the concluding volume of a treatise which is to be regarded as a classic. This third part treats most exhaustively of polarization in melted electrolytes, cells with melted electrolytes, the application of the Gibbs-Helmholtz equation to the electromotive force of such cells, the decomposition voltage of melted electrolytes, and the application of the theory of electrolytic dissociation or ionization, to such electrolytes. Throughout this mass of material is to be seen and appreciated the broad-minded way in which the subject is handled, and the very important light which the information sheds on the phenomenon of electrolysis in its most general aspects. The important conclusion drawn in the last chapter is that if solutions are examples of ionization, then all melted and solid salts which conduct are likewise more or less ionized. The work is recommended to the best attention of everyone interested in electrochemistry.

DIE BETRIEBSMITTEL DER ELEKTRISCHEN EISENBAHNEN. By E. C. Zehme. Wiesbaden: C. W. Kreidels Verlag. 317 pages, 315 illustrations, 66 plates.

This book purports to be a street railway handbook. In that respect its dimensions rather belie its name, for the pages are eight by eleven inches, and the volume is at least one and one-half inches in thickness. The information that it contains is not compressed into handbook form, but is on the other hand rather elaborated.

The first pages of the book are devoted to a discussion of tracks, wheel bases, trucks and their component parts. Valuable information is given with reference to wheels, their contact with the rail heads and the wear, strength of axles and the stresses upon them. These subjects are discussed to a degree mathematically, and suspension springs and suspensions also have a mathematical discussion. The placing of motors, brake lever systems and the like are also illustrated and discussed.

Following this come control combinations for railroad motors illustrated in diagram. Next a treatise on air brakes and air brake mechanisms and also electric brakes, an illustration of a multiple unit system of electric braking being displayed. Some features of car construction follow, in which matters are taken up in considerable detail. The chapter on heating displays different forms of heaters and their method of connection to the trolley systems.

Electric locomotives next receive attention, and in this respect a considerable amount of data is presented copiously illustrated by diagrams and drawings from manufacturers' blueprints. Following this is a discussion of the selection of railroad motors with reference to the service they are to perform, taking account of grades and desired schedules. This section is copiously illustrated by curves and diagrams.

The next section of the book is devoted to the general theory of the electric motor, and is practically an abridged treatise on dynamo-electric machinery. The author does not hesitate to go into ancient history and devotes a great deal of space to illustrating many forms which have long since become obsolete; and although some attention has been given to modern practice the book can hardly be said to be up to date or even up to the past five years, especially as regards American practice. A chapter on alternating-current motors follows. This is limited to the induction motor practice and does not discuss the later forms of series and compensating commutator motors using alternating current. Next follows a chapter on motor suspensions which is very brief and is confined to suspensions of considerably older date than is now considered present practice. Then follows a short discussion on methods of gearing, which is succeeded by a more extensive discussion on systems of motor control, both alternating and direct-current, after which many diagrams of controller construction are discussed. The multiple unit system ,however, receive very scant attention. A discussion follows on the subject of trolleys and current collectors of various kinds.

Circuit breakers and switches are given a few paragraphs and some interesting data on high-tension switches and lightning arresters are given, forming the closing chapters of the book.

The plates in the back of the book are largely copies of manufacturers' blueprints, although some are original drawings. The book being a German production naturally leans to descriptions of European practice, and in this respect is useful to the American railway engineer as dealing in ideas out of the ruts into which American design and construction of rail way apparatus have drifted. While the book cannot be considered as highly mathematical, and much of it can be appreciated without a knowledge of the higher mathematics; yet the writer does not hesitate to employ mathematical demonstrations wherever he thinks them needful. It is a general treatise on the subject and cannot by any means be considered a handbook of reference, as the lack of common data and compressed information precludes such a characterization.

Experience with Magnetite Arc Lamps at Harrisburg, Pa.

The streets of Harrisburg, Pa., were formerly lighted by open arc lamps operated on the old Excelsior and T-H systems. A little over a year ago the Harrisburg Light, Heat & Power Company, which has the contract for the public lighting, ordered 800 magnetite arc lamps and six 140-light, 4-amp. Brush arc machines, and at the same time made arrangements for changing over the street lighting system just as soon as the dynamos were placed in position. In December, 1905, the first machine was delivered and as the lamps were received they were placed in position until now there are 761 magnetite lamps in circuit, of which 503 are on public street circuits and the remainder on commercial circuits.

The lamp, which has been only recently introduced, is suitable only for outdoor use and possesses for this purpose a number of advantages. A comparatively high efficiency is obtained together with an improved distribution of the light, and the color of the latter is very white. The lamps are designed for operation on direct-current series circuits at 4 amperes and 75 to 80 volts, which may be supplied by Brush arc machines, as is done at Harrisburg, or by mercury arc rectifiers connected to alternating-current circuits. The lower electrode is of specially prepared composition (magnetite) contained in an iron tube and has a life of 140 to 160 hours. The upper electrode is of copper so designed as to remain at a comparatively low temperature and has an estimaed life of about 4,000 hours. The main frame of the lamp consists of a single tube which serves as a chimney for carrying away the fumes of the arc. Inasmuch as the position of the arc does not change as the lamp burns, the lamp has been designed with a small horizontal reflector of white enameled iron placed inside the globe and close to the arc.

Adjustments are few and easily made. The length of the arc is controlled by an adjustable stop on the left-hand guide rod. The starting, or pick-up voltage is approximately 75 volts. To increase the arc voltage the stop is raised and to decrease the voltage the stop is lowered, after which the lower electrode is tripped and then pushed up again as in trimming. The shunt magnet is adjusted by raising or lowering the armature disc and the check nut. If the lamp feeds too often, the disc is turned to the left, and if not often enough the disc is turned to the right. The shunt magnet is in multiple with the arc and should close the contacts when the arc voltage rises momentarily to 110 volts. This occurs when the average voltage is approximately 80 volts. The positive, or upper, electrode is free and has ⅛-in. play between the top of its wing and the top of the slot on the iron box through which it moves. The armature and lower electrode drop back at

least 3/16 in. instantly before retarded by the dash pot, when they descend slowly with the dash pot. The spring which is fastened to the lever of the lower clutch has enough tension to keep the toe of the clutch engaged with the electrode holder rod, but does not prevent the body of the clutch from resting on the lower guide plate.

In trimming, the outer globe is unlatched and the tripping rod pushed up until the clutch in the lamp is disengaged. The old electrode is then readily removed and replaced, care being exercised to have it align with the center of the positive electrode. If the electrodes are not in line the arc will play from one side of the upper electrode and give poor operation. The lower electrode mechanism is then thrust up until the electrodes come in contact and drops freely when the hand is removed. It is necessary at every trimming to clean the center tube with a small brush, as otherwise the reddish-brown fumes accumulate and clog the tube and settle on the inside of the globe, making it opaque. The negative electrode is 5/8 in. in diameter and is 8 in. long. The upper electrode is reversible with an approximate life of 40,000 hours.

When the lamp is started, the current passes through the starting magnets and carbon contacts of the cut-out, thence through the starting resistance to the line. The starting magnets become energized, lifting the lower electrode until it comes in contact with the upper electrode, when the current flows through the electrode circuit in which is the series magnet. This magnet becomes energized, separating the carbon contacts and cutting into circuit the shunt magnet. The weakening of the starting magnets allows the lower electrode mechanism to fall until supported by the clutch. The lamp burns in this position until the lower electrode has been consumed so that the increased arc voltage will cause the shunt

FIG. 1.—MAGNETITE ARC LAMP.

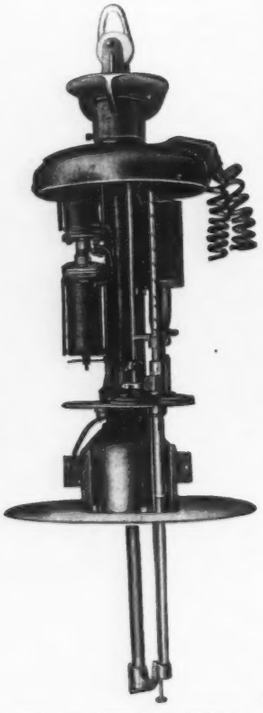


FIG. 2.—VIEW OF MECHANISM.

feeding magnet to close the carbon contacts. The starting magnets are again energized, raising the lower electrode until both electrodes are again in contact.

From careful records kept by the Harrisburg Light, Heat & Power Company, the cost of maintaining the electrodes is $1.60 per lamp per year. The repairs and renewals were abnormally high, for the reason that the company changed the entire outfit so as to use a new type of electrode, the old electrode having a rocker arrangement. This change brought the yearly cost of repairs and renewals up to about $2.00 per lamp. With the equipment in the Harrisburg sta-

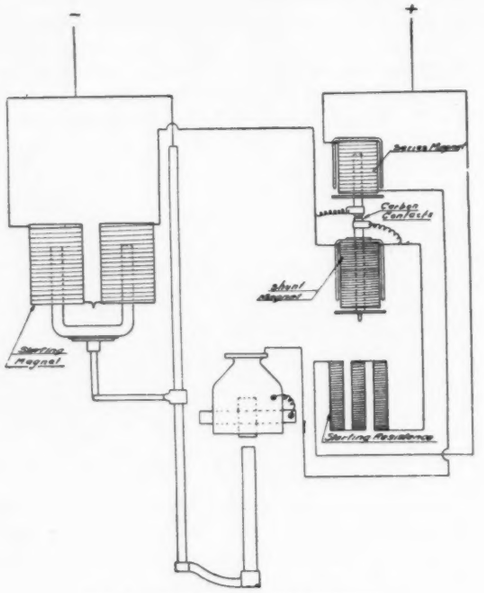


FIG. 3.—DIAGRAM OF CONNECTIONS.

tion it is found that unless the machine is turned on with a jerk or made to flash so as to throw a sort of shock on the line, all the lamps will not start. This is due to minute particles of magnetite getting between the electrodes and acting as sort of insulators. By causing the lamp to flicker a number of times the arc is finally struck.

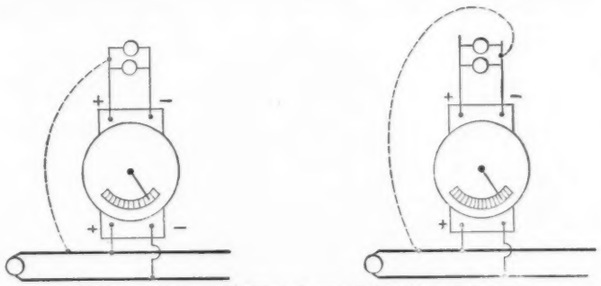
Since the lamps are trimmed only every 150 hours or every 10 or 12 days, the accumulation of reddish-brown dust at the end of that time, while slight, is still sufficient to absorb much light. The company has found that the quickest way to clean this from the globes is by the use of cheese cloth dampened with coal oil. The company has also found that it is necessary to use care in centering the electrode in the chimney as at first much unsatisfactory operation was traced to this cause. The lamps are quite heavy, weighing about 50 pounds each, and are hung rather low. The reading distance, as compared with open or enclosed arc lamps, is increased one-third. The cost of maintenance is not so great, and with the 761 lamps connected in circuit, only one man is required to trim all the lamps. It is the opinion of Mr. Kinter, the manager of the Harrisburg Light, Heat & Power Company, that the lamp is as far ahead of the enclosed arc lamp as that lamp is ahead of the old Excelsior arc lamp.

Electric Leakage Indicator.

The electric leakage indicator shown in the accompanying illustration has recently been brought out in England. When fixed it is continuously in circuit, and indicates, whether the load is on or not, a leakage immediately it occurs. As no earth connection is used, it indicates only the leakage occurring upon the actual circuit in which it is fixed, in contradistinction to leakage indicators using an earth connection, which show the leakage common to the whole system of supply and consumption. Two separate windings each carry a current and in conjunction with this coil is a magnetic needle fitted with a pointer which will, when current traverses both of the windings, take up a position depending mainly upon the difference between the two currents passing. If the latter are exactly equal, then the pointer takes a median or zero position. The

wires are twisted to render the mean distances of the turns and twists of the wires practically equal so that the deflection shall vary with the difference of the currents in the two wires. By very simple means this principle is utilized in the new indicator for the efficient indicating of a small leakage, automatically checking and obviating leakage from a conductor, actuating an alarm bell, a cut-out, etc.

Apart from the usefulness and convenience of an instrument of this type when fixed in the house, where it prevents waste of current, destruction of gas and water pipes by electrolysis with subsequent damages and risks and fires due to electric causes,



FIGS. 1 AND 2.—DIAGRAMS OF LEAKAGE INDICATOR.

it also gives the central station ready means to determine the amount of leakage occurring upon the consumer's installation, the meter reader simply noting the reading of the indicator at his usual visits and reporting the same, which is certainly quicker and simpler than the usual "insulation test" with its interruption of service, etc. With the new indicator a fault when indicated can be easily located by turning on the current and drawing and replacing the branch fuses one by one until the fault disappears.

The leakage is measured directly on the scale in milliamperes, and at a point on the dial a distinct mark indicates that the installation requires attention. The consumer hitherto had no means of knowing, without skilled assistance, whether leakage was occurring. With a gas consumer it is different, the odor

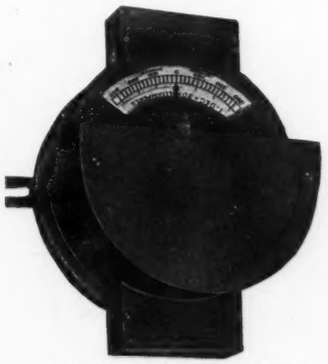


FIG. 3.—LEAKAGE INDICATOR.

bringing the fault immediately under notice. In England it is a very common occurrence to find a leakage equivalent to the current required to light an ordinary 8-cp lamp, which going on unchecked amounts in a year to payments in the aggregate more than the cost of an instrument.

The instrument described is made by the Electric Safety Appliances Company, Eldon Street, Finsbury, London.

Direct-Current Motors.

The Rossmassler-Bonine Electric Company, of Philadelphia, Pa., has brought out a new line of small direct-current motors ranging in size from ⅛ to ¾ hp for operating the many classes of machines to which electric drive is best adapted. Reference to Fig. 1 will show that the motors are neat, compact and of sturdy design. Two sizes of frames are listed, both of which are regularly wound for 115, 230 and 500 volts and can also be furnished either series or compound. The motors can be specially wound for high or low speeds. The yoke or magnet frame and the poles are cast in one piece of steel. The latter are provided with laminated shoes, and the feet are cast with the yoke, thereby obtaining a very rigid and secure means of support. The field coils are form-wound and are held in place by the laminated pole shoes. They are covered by the form of the yoke and the leads are of heavy rubber-covered cable placed to avoid danger of breaking. The armature construction follows best practice, and the windings are impregnated with a moisture and oil-proof compound. They are retained in the slots by wedges, no band wires being used. The steel shaft is ground

FIG. 1.—SMALL DIRECT-CURRENT MOTOR.

to size and is provided with a key for securing the pulley or pinion, a construction superior to that of using a flat spot for holding the pulley, as is often found in small motors. The commutator is of the bolted-through construction similar in design to that found on the largest types of generators. The leads from the winding are soldered directly into slots milled

FIG. 2.—CONSTITUENT PARTS OF MOTOR.

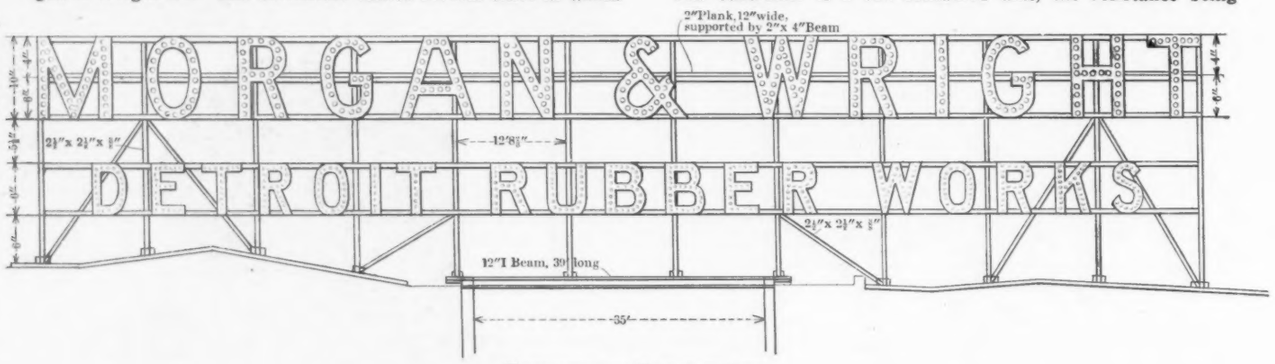
in the ends of the segments and are protected by a covering of tape and cord.

The brush holders are of the swinging arm type mounted on studs, and are designed to permit the tension of the brush springs to be readily adjusted. Carbon brushes are used. The bearings are made of bronze and are provided with lubricating rings running in large oil wells. Drains are formed in the outer faces of the housings to prevent oil flowing to the inside of the machine, should the wells be too full. The bearing housings, which carry the brush rigging and oil wells, are centered in the field by a turned recess and bolted thereto by cap screws. The latter are placed 90° apart, permitting the housings to be rotated when the machine is mounted on a wall or ceiling. The rotating parts are said to be carefully balanced and the magnetic circuit so proportioned that the motors operate without noise or vibration. Overloads of 50 per cent, it is claimed, can be carried without noticeable sparking and temporary heavy

overloads produce no harmful effects. All parts are inspected before assembling, and machines are given a full load and overload running test before shipment. Should a completely enclosed motor be desired, plate covers for the openings in the housings may be secured. All parts are made to gauge.

Large Electric Sign.

One of the largest electric signs in the world is to be installed at Detroit by the Morgan & Wright Co. A thorough study of electric signs was made by a special committee of the Morgan & Wright Co. The committee visited several cities in which



Elevation of Electric Sign.

were installed some of the largest and best electric signs, and after carefully making up their minds as to the kind of sign they wanted, they requested the various sign companies to each make a 6-ft. letter R in the very best method of construction, and to install it on the roof of their new building facing the Detroit River. After the officials had made an examination of the details of construction the letters were all illuminated and viewed from different angles by the committee at night to find out which letter had the greatest angle effect. The same kind of test was made in daylight to find the best day effect.

Specifications stated that the sign was to be installed on two buildings facing Detroit River; to extend from the extreme sides of the building and bridge over a span of 36 ft., a distance altogether of 140 ft. The height was to be 30 ft., and the sign was to be installed on an angle iron frame of sufficient size and strength to support the letters and resist the wind pressure of this location. The letters were to be made of No. 22 gauge galvanized iron. The committee selected a letter made in the concave groove method of construction with a face of one and one half inches for daylight effect. This letter was made by the A. & W. Electric Sign Co., of Cleveland, and is known as its A. & W. groove letter. The company has made a specialty of this style of construction for years. The sign, as per sketch herewith, will be 140 ft. long and 30 ft. high, and will extend from the roof of one building across a span of 36 ft. to the roof of a second building. The name Morgan & Wright will form the top line in letters 10 ft. high, and Detroit Rubber Works, the second line, in letters 6 ft. high. The face of the letters will be gold-leafed for day effect and the sides painted green which will make an excellent combination for a day sign. The sign will require about 1,400 lamps and will be installed ready for lighting about April 1, 1907.

New Line of Controllers.

The Electric Controller & Supply Company, of Cleveland, Ohio, is placing upon the market a new line of controllers built to meet the requirements of general crane service where the conditions are not severe enough to demand the use of the Dinkey ventilated controller. The smaller sizes are built with coil resistance and the larger with cast grid resistance. When it is desired to place controllers above or in the rear of the operator the controller is arranged for under lever operation. They are also provided with a spring return mechanism for operation from the floor by means of pendant ropes or chains. Many crane users have decided that a 15 or 20-ton crane requiring a 25 or 30-hp motor on the hoist and bridge motions may be operated from the floor by any of the men in the shop, thus saving the wages of a crane operator, who would probably be idle half his time. It is a very simple matter to put cut-outs at either end of the trolley travel and at either end of the runway to prevent accident. The present controller meets this demand for motors up to 50 hp arranged for operation from the floor by means of ropes.

The controller is a self-contained unit, the resistance being placed in the frame, making it necessary to run only four wires between the controller and the motor. Reversal is accomplished by the use of a single lever, no separate reverse switch being required. All parts are made to jig and are interchangeable. The contact face is of heavy slate free from metallic veins. The contact segments are of copper, which are screwed to brass lugs

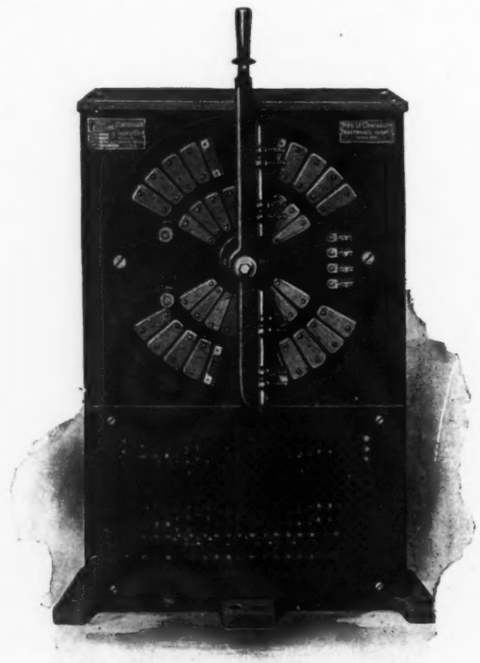


Fig. I.—Controller with Wire Resistance.

to which all wiring connections are made. By this construction any of the contact segments can be removed and replaced without disturbing the wiring connections. The contact arm is of soft cast iron and carries the fingers and finger holders, the insulation of which is of heavy pressed vulcabeston bushings. The contact fingers are of dropped forge copper of great hardness and may be removed and replaced without removing the contact arm.

A powerful and effective blow-out is provided in all sizes of these controllers. The frame for the smaller controllers consists of a main casting in one piece provided with a cover, the removal of which affords easy access to all resistance connections. The case enclosing this frame is of perforated steel, thus allowing ample ventilation. The frame of the larger controllers consists of a bottom casting which supports the resistance, and a top casting which supports the contact slate and arm. The top and bottom castings are connected by means of four steel corner posts around which a casing of perforated steel is provided for ventilation and protection to the resistance. The top casting of the latter controllers supports the contact slate, which is completely covered and protected by a sheet steel casing; it protects the

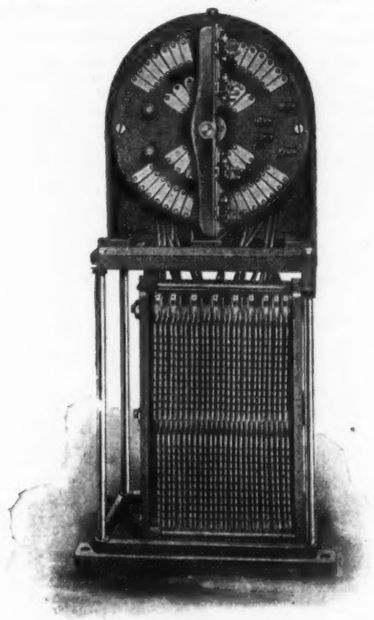


FIG. 2.—CONTROLLER WITH GRID RESISTANCE.

operator from coming in contact with any live parts of the controller, and also protects the working parts of the controller from dust and dirt. Easy operation is secured by a lever, which is keyed to the arm shaft at the back of the top casting, which gives a short movement of about 10 in. in either direction for both starting and reversing. The resistance for the controller shown in Fig. 1 is built of cast grids in a single bank, which may easily be removed as a unit without disturbing the other parts or moving the controller. The resistance for the controller illustrated in Fig. 2 is made of two banks supported on bars attached to the frame, and may be removed in separate units without disturbing the other parts.

The Alpha and Omega Toggle.

A couple of designs of toggle bolts which are coming into very extensive use by electrical contractors for screwing fixtures to walls and ceilings or for any of the uses to which a toggle bolt can be put, are made by the Alpha and Omega Toggle Company, of 269 Dearborn Street, Chicago. Mr. A. L. Ellis, manager of the company, claims to be able to show some of the largest toggle orders ever placed. The Alpha toggle, Figs. 1 and 2, is made for bolts. Its action will be apparent from Fig. 1, which shows the toggle as it appears after it has been inserted and the bolt is ready to be tightened, and Fig. 2, which shows the toggle while being inserted in the hole in the wall. The advantages claimed for this toggle are that the bolt can be screwed in with the fingers to any desired point and then capped with a neat finished nut of any of the three designs shown instead of cutting off the part of the bolt, as in common toggle bolts, as soon as the outer nut is tightened, the clutch action of the pivoted nut through which the bolt is screwed holds the bolt. The toggle head is balanced so as to fall into or out of position by a half-turn of the bolt after it has been placed in the wall. This makes it possible to take the toggle out, if desired. The inner end of the bolt has its thread upset to prevent it entirely unscrewing out of the pivoted nut.

The Omega toggle, Fig. 3, is claimed to be the only toggle adapted to the use of common wood screws. It is intended only for light duty. Two springs are riveted in each end of

FIGS. 1, 2 AND 3.—TOGGLE.

the head and meet in the center over the hole through which the screw passes. The abutting ends of these springs are punched out in a half circle to fit either a No. 10 or the No. 12 screw, as ordered. As soon as the screw begins to tighten up, the springs clamp it and prevent it from being pulled out. The string shown is merely to hold the head inside the wall while the screw is being entered. The string is afterwards cut off.

Electric Switches for All Classes of Service.

When a company announces that it has listed over 45,000 separate switches, its claim of making the most complete line of switches is fairly well substantiated; and this announcement is made by the Trumbull Electric Manufacturing Company, of Plainville, Conn. Every possible combination is made by this company including front and back connected, quick-break, double-break, quick-break and double-break, fused and unfused, plain and polished, direct-current and alternating-current for 110, 250, 440 and 600 volts, ranging from 15 to 2,500 amperes and covering both the "Type A" switch shown herewith and "Type C" switch.

The company states that there is no type of switch that it cannot supply. Its special department is said to be well equipped to turn out work rapidly, since the company carries in stock, it is claimed, more knife switch material than any other company in the country. For this reason there is no delay due to lack of stock.

The design and workmanship of the switches made by this company are first-class throughout, if careful conforming in all points of detail to the requirements of the Underwriters and

SWITCH.

their approval, means a first-grade switch. The "Type A" switch according to a recent test made by the Electrical Testing Laboratories showed a rise of temperature from 25 to 50 per cent below that allowed by the Code. Special attention is given during assembling to the points of contact, and each switch is carefully inspected for this purpose alone. This, with the ample material used, is said to account for the excellent carrying capacity of the switches.

Third-Rail Brackets.

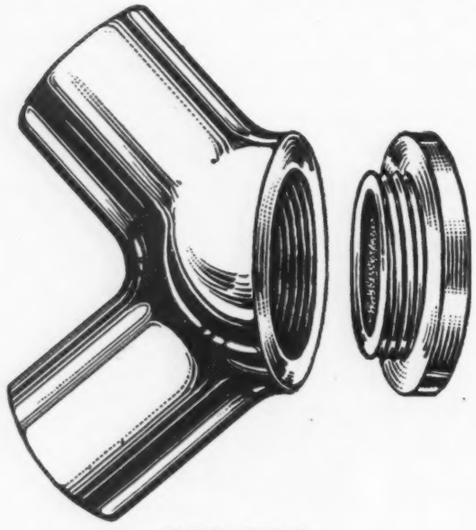
The Beaver Dam Malleable Iron Company, of Beaver Dam, Wis., which makes a specialty of malleable castings for electric railways, manufactures the form of third-rail bracket shown

THIRD-RAIL BRACKET.

herewith, which has been adopted for use on a number of lines. The same company makes a number of different kinds of third-rail brackets, but that shown is the one that is most commonly used.

Fittings for Conduit Work.

The accompanying cut illustrates a new short "ell" fitting for conduit, which allows very short bends to be placed in a conduit system. It is fitted with a weatherproof screw cap opening, through which the wires can be easily passed around the sharp angle. It is neat in appearance and is made in all



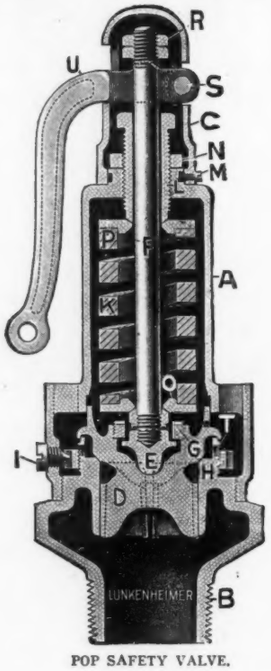
CONDUIT FITTING.

standard sizes. It is being extensively used on interior conduit service, also in underground work, and wherever a short bend is needed to make a neat conduit job. These fittings are galvanized throughout and are treated inside with a heavy coat of insulating enamel. They are made by the Fairmount Electric Mfg. Co., Philadelphia, Pa., and are distributed to the trade by J. C. Vogel, general sales agent, 714 N. 24th St., Philadelphia, Pa.

Improved Pop Safety Valve.

The Lunkenheimer Company, of Cincinnati, Ohio, has lately redesigned its pop safety valve, and as now constructed the valve is made of the very highest grade of bronze composition, is well finished in every respect, and has large springs, insuring great durability. It is very simple in construction, and is warranted to be reliable, accurate and positive in operation. The valve has full relieving capacity, is very sensitive to excessive pressure, and admits of being finely adjusted.

The valve is provided with lock-key attachment, to guard against being tampered with, and adjustments of pop lid and pressure can be made from the outside of the valve without taking it apart. The springs rest between ball and socket plates, which equally divide the pressure on the disc, and are also encased, hence the valve cannot be affected by back pressure. The valve has bevel seats, at an angle of 45 degrees to the vertical axis, is provided with suitable levers by means of which the discs can be raised from their seats and is allowed the very highest rating; i. e., one square inch of valve area



POP SAFETY VALVE.

to every three square feet of grate surface of boilers. To take the valve apart, the lever *U* is removed, then the bonnet *C*, after which the load on the spring is relieved by unscrewing the regulating screw *L*. The regulating ring screw *I*, is then removed, and the bell *A* unscrewed. To set the valve for a higher pressure, it is only necessary to turn the regulating screws *L* down, and for a lower pressure, to turn it up.

The pop or action of the escaping steam is regulated by the ring *H*, in the base of the valve, which is easily accessible, without taking the valve apart, and it is held securely in place when set by the regulating ring screw, *I*, shown on the left-hand side of the bell.

If the valve pops suddenly and does not relieve the pressure enough, the ring *H* is turned up which covers the drill holes and causes the disc to remain longer off its seat. If the valve pops too much, opening and closing gradually, then the ring *H* is turned down.

When the desired adjustment is obtained, the ring is secured by means of the screw *I*.

There are a great many of these valves in use, and the Lunkenheimer Company claims that the demand for them is steadily increasing, and that they are giving perfect satisfaction wherever installed.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports of trade and industry were generally favorable, better weather conditions and the easing of the railroad blockades being largely instrumental in this direction. Better reports come from the northwest, where the railroads are beginning to get back to normal conditions, and on the north Pacific Coast, where the car congestion is less acute, and preparations for Spring trade are noted. There is also a better tone to advices from the South Atlantic States. A very large acreage of cotton seems certain the coming Spring. There were fewer business failures during the week, the number as reported by *Bradstreet's* being 177 against 204 in the week previous, and 186 in the corresponding week of last year. Building as a whole does not show signs of equalling the record volume of 1906. The recent announcements by leading railroads of the curtailment or postponement of extensive improvements, owing to high cost of labor and materials or to the high rates demanded on new issues of securities, exert some influence upon sentiment as regards future commitments in materials likely to be used in railway extension. Collections are still irregular but tend to slowness, as retail trade in Winter goods is about over and Spring business has hardly commenced. In iron and steel activity continues. Consumers of steel-making iron appear indisposed to come into the market until further concessions are made. Steel is in better supply, and finished lines make excellent reports. New orders for steel rails make up a comparatively large tonnage, considering the heavy volume heretofore placed, sales for the week aggregating about 40,000 tons. Much more export business is proffered in this market than most manufacturers are able to book under conditions as to deliveries through the Summer. In structural steel the inflow of important specifications assures all the business that the associated and independent mills can turn out during this year. Prices in all lines of steel products remain unchanged. From the distributor's point of view, prices have reached high-tide conditions. The copper market was strong for prompt shipments. As the larger copper consumers in this country survey conditions, the position of the metal is steadily consolidating under imperative, progressive and steady demands. Demands for No. 12 copper wire, largely used in telephone cable work, are so enormous as to put the wire mills farther behind in shipments than ever before. It is stated incidentally that the amount of copper consumed by the electrical engineering trades in this country is about 40 per cent of the country's entire consumption. In Germany half the consumption of copper is by the electrical engineering trades. Prices for large tonnage of electrolytic are at 25 a 25½c., the majority of sales by producers being at 25¼c. for May and June. Lake is quoted at 25½c. a 25⅝c. with little to be had for any delivery, because most of the consumers are eagerly waiting for the opening of the producers' books for June.

THE SITUATION IN COPPER.—The National Conduit & Cable Company in its "Copper Gossip" bulletin of February 20 says: "The situation as regards the copper market shows a tendency to continued firmness, and there is no semblance at this writing of an immediate change in the character of the market. There has been very little fluctuation in local quotations for a considerable time, and new business for several weeks did not figure up to the heavy transactions we were accustomed to hear of a few months ago. A fresh buying movement was started recently, however, which resulted in producers disposing of large quantities of copper for future deliveries. Latest sales include deliveries up to May and June. The market for distant futures now quotes 25¼ to 25½ for electolytic wire bars, with Lake as high as 26c. for the best brands. If we are able to rightly gauge conditions, consumers of copper, to an extent more or less annoying, are compelled to operate their plants under disadvantages because of the inability to procure copper up to the level of their requirements during the next two or three months. There is no question but that some of the leading consuming interests deem it inconsistent with conservative methods and strictly sound business principles to run short-handed for the next ninety days, and at the same time jump into the market and load themselves up with copper at present prices, for which they cannot obtain delivery before the months of May, June and July. What the level-headed manufacturer specially wants is copper now wherewith he can fill his orders in February, March and April, and when April comes round he will be fully prepared to negotiate for his May, June and July copper on the market basis then current. Consumers of copper are in the position where they want to be reassured to a tolerably definite extent that everything possible will be done to prevent a scantiness in the supplies of raw material. This is necessary for the promotion of good and satisfactory business conditions. The present remarkable success of the entire copper mining industry is owing to the enormous demand for the product of the companies furnishing the metal, and every consumer is contributing his quota to the marvelous prosperity of the copper companies. We disclaim most postively any disposition whatsoever to make any rash or unmerited criticism on the methods of producing interests or to dictate what their policy should be, but we do believe the importance and magnitude of the establishments melting down copper in this country is such that they may rightly claim every reasonable consideration from those who have it in their power to adjust matters to prevailing conditions, so that the least possible hardship or injury will be done to the great and influential body of manufacturers dependent upon copper for from 75 to 90 per cent. of their raw material."

POWER PLANT FOR ROANOKE.—The Roanoke, Va., Railway & Electric Company is about to erect and equip a power plant to cost $250,000 on a site just purchased from the Norfolk & Western Railway Company. The general manager, Mr. J. W. Hancock, states that the plant will comprise three turbo-generator units, one of 1,500 kw capacity and two of 500 kw each. There will also be five boilers of 400 hp capacity each. The building will be 100 by 150 ft. Mr. Hancock says: "This expenditure of $225,000 for a new power station is only a part of the total amount the Roanoke Railway & Electric Company has contracted to spend this year. At the semi-annual meeting of the board of directors last December it was voted to appropriate $108,000 for improvements to be made this year. So there is a total of $333,000. We have already bought four new street cars, Brill cars of the newest design, two of which are for use on the Salem line; and we have ordered new rail for the extension of our double track work at Jefferson Street and Salem Avenue, and for laying new tracks on other parts of the street railway system. These and other improvements are to be paid for out of that appropriation of $108,000. Ultimately we shall have a generating plant, an electric railway system and an electric lighting service that will be hard to beat in any city of the size of Roanoke in the United States. The officers and directors of this company believe in the future of this town and appreciate the opportunities it offers, and therefore they are willing to invest their money here to give the people of this city the best possible service in electric traction, electric light and electric power."

NEW ELECTRIC AUTO.—An electric surrey, with a reclining chair in place of the customary rear seat, has just been constructed for Gen. William J. Palmer, who is now living in Colorado Springs, where he has been recovering from a serious accident last summer, when he was thrown from his horse, severely injuring his neck. Always fond of open-air exercises, Gen. Palmer has been anxious to obtain an easy riding carriage, in which he would be free from all vibration and jar. An electric vehicle was suggested, and a Pope-Waverley surrey especially constructed for ease and convenience in riding has just been ordered from the A. G. Southworth Company, of 1,733 Broadway, the New York agents for the Pope cars. The car will have an extension leather top, and a large reclining chair will be fitted in the rear. There is no reason why such a vehicle should not be generally available for invalids.

WIRELESS FOR WRECKING CO.—It is stated that Mr. John Arbuckle, the sugar manufacturer and coffee importer of Brooklyn, who has fitted up a fleet of powerful ocean-going tugs and barges and equipped them with all the appliances for saving lives imperiled on wrecking vessels, has found it necessary to appeal to Congress for aid in carrying out his scheme. When Mr. Arbuckle first announced that his life-saving tugs were ready to go into commission he sought to come to an understanding with the Life-saving Service whereby his vessels should be notified by wireless telegraph whenever a disabled or wrecked ship was sighted along the coast. Although his plan had been fully approved by President Roosevelt, Mr. Arbuckle says he has not found the Life-saving Service willing to co-operate with him. The tugs and barges of the John Arbuckle Life-Saving Company, which are to be stationed off the Sandy Hook Lightship, are built to weather the hardest kind of a blow and the roughest seas. They will be able to go out to stranded vessels when it would be impossible to launch the lifeboats of the regular Life-saving Service. These vessels are also being fitted with electric searchlights; and Mr. Arbuckle has now circularized every representative and senator in favor of a bill compelling wireless notification to the fleet.

FLAMING ARCS AT NEW YORK POST OFFICE.—The six Excello flaming arcs recently erected at the north mailing platform of the U. S. Post Office, Park Row, have attracted considerable attention, being an installation very demonstrative of the great luminosity and efficiency of these lamps. It was found that the former illuminants, consisting of an aggregate of ten ordinary enclosed arcs, and some eighty-two incandescent clusters were insufficient for the handling of the enormous mailing business transacted there. To get three times the light with a reduction of load at the same time was the problem the Post Office authorities were confronted with. The merits of the Excello flaming arcs were carefully gone into and as a result an installation of six 10 ampere lamps was decided upon. The partial tests proved that these six lamps not only gave all the light requisite, but that the current consumption of the platform illuminants was reduced fully 60 per cent. It is stated that not only the officials of the United States Treasury engineering department, but the platform operators, are very much pleased with the results. The lamps used in this installation were installed by the Excello Arc Lamp Co., 24 East 21st St., New York.

WIRE PLANT FIRE.—A dispatch from Rome, N. Y., states that a fire originating in the boiler room has destroyed the factory of the Wire & Telephone Company of America, the damage being estimated at $200,000. The fire will in no way interfere with their taking care of the requirements of their trade as heretofore. Owing to their resourcefulness and quick action, every provision has been made to make deliveries and to accept new business on all of their products. The fire, which destroyed only the wire-drawing plant, was no sooner under control than arrangements were being made by them for the drawing of their wire by other mills. Their representatives were instructed to accept orders and assure customers of deliveries as though there had been no fire. The buildings in which they manufacture magnet wire, rubber covered wire and telephone products, were not damaged in the least, and operations have been resumed. The Wire & Telephone Company of America has already made contracts for the erection of a new wire-drawing plant, which will be pushed to the earliest possible completion, and will have a greatly increased capacity.

WHITE STAR OIL FILTERS.—Sales of White Star Oil filters by the Pittsburg Gauge & Supply Co., Pittsburg, have been made recently to the following concerns: Eleanora Mines, R. & P. C. & I. Co., Eleanora, Pa.; Donohoke Coke Co., Greensburg, Pa.; Wm. H. McCarthy, Pittsburg, Pa.; Pittsburg Steel Construction Co., Economy, Pa.; Penn. R. R., Pittsburg Shops, Pittsburg, Pa.; Trumbull Electric Mfg. Co., Plainville, Conn.; Powell, Clouds & Co., Philadelphia, Pa.; Pratt & Whitney Co., Hartford, Conn.; Pittsburg Steel Co., Monessen, Pa.; John A. Roebling Sons Co., Kinkara, N. J.; Bryan Marsh Electric Co., Central Falls, R. I.; Louisville Lighting Co., Louisville, Ky.; Auburn & Alton Coal Co., Auburn, Ill.; Laurel Mfg. Co., Laurel, W. Va.; American Steel & Wire Co., Chicago, Ill.; Carterville & Big Muddy Coal Co., Carterville, Ill.; Russell Coal Mining Co., Clymer, Pa.; Milburn Wagon Co., Toledo, O.; Pittsfield Electric St. Ry. Co., Pittsfield, Mass.; Cincinnati Water Works, Cincinnati, O.

SUBMARINE SIGNALS.—It is stated from Boston that orders for the installation of the Submarine Signal Company's system from the shipping interests of both this country and of Europe are coming in at a rate which promises a record year. The company has recently received an order from the British Admiralty for the equipment of King Edward's private yacht *Victoria and Albert*. The rental which the company receives ranges from $75 to $800 per annum, which rates prevail throughout the foreign countries, as well as in the United States. Apparatus is sold outright to governments for equipping naval vessels, on a basis of ten years' rental. It is generally understood that the insurance companies will, in a few months, consider an advance in insurance rates, and when this advance comes, it is thought probable that vessels equipped with the submarine signal will be made a preferred class.

WESTINGHOUSE ENLARGEMENT.—The Westinghouse Electric & Manufacturing Co. has broken ground at East Pittsburgh for the foundation of a new factory building as an addition to the electric works which is to cost about $500,000. The building will be eight stories high and a fireproof structure of brick and steel construction; its dimensions will be 400 by 70 feet. Six acres of floor space will be added to the floor area of the shops, which already amounts to more than 40 acres. The present capacity of the East Pittsburgh works reached an output during last year of apparatus approximating in value $40,000,000, with 17,500 employes, but with the addition of this new structure it is expected that 20,000 will be employed by the electric company, which will bring the number of Westinghouse employes in the Turtle Creek Valley alone up to about 35,000.

THE SARCO FUEL SAVING & ENGINEERING COMPANY has absorbed the business heretofore carried on by John A. Caldwell at 45 Broadway, New York, in fuel saving devices, including the "Ados" CO_2 recorder. The Sarco Company has just been incorporated with a capital of $100,000 to take over the American interests of Sanders, Rehders & Co., Ltd., fuel economy specialists of London and Manchester, and to manufacture on this side their various lines. Mr. Sanders, the chairman of this firm, is the president of the new company, and Mr. Caldwell is the general manager. Offices have been engaged in the new West Street Building and workshops and temporary offices at 81 Washington Street, New York.

A TOKIO SUBWAY.—The Belgian legation in Tokio reports particulars of a scheme to construct an underground railway. The distance is about 12 miles, and the cost is estimated as low as $625,000 a mile. A company is to be formed with a capital of $7,500,000. It is expected that a uniform fare of 2½ cents will produce a dividend of 8⅕ per cent. *The Commercial* adds that as soon as the scheme became known other towns in Japan desired that plans for similar undertakings should be prepared for them. The Electric Tramway Company of Tokio has asked for sanction to extend its system by the construction of an addition of 60 miles.

PLANT FOR AVOCA, PA.—To provide for the rapidly increasing demand for electricity for power and light in the territory served by the Standard Electric Light, Heat & Power Company, of Avoca, Pa., the plant will be increased by the addition of a 300-kw engine type alternator, 2,200 volts, 60 cycles, two-phase, with engine, switchboard, exciter and other accessories. This improvement and extension is in line with the policy that has marked the rapid growth of this aggressive and successful system. Mr. Frank Howard is the superintendent and manager.

MINING EQUIPMENT.—The Black Butte Consolidated Co. is to develop its Diamondfield, Nev., property on a large scale. The old shaft, which was sunk to a depth of 140 feet on the north side of the Butte, has been enlarged to a three-compartment affair and is now down to a depth of 160 feet. The mine is to be equipped with the latest, up-to-date machinery. A 75-horse-power electric hoisting plant, an eight-drill air compressor, electric pumps, and, a complete outfit has been ordered. The old shaft will be sunk down to a depth of 500 feet.

CARS FOR INTERBOROUGH.—The Interborough Rapid Transit Co. has ordered 200 cars for the Manhattan Elevated Railroad and 50 for the subway. The subway cars are to be all steel and fireproof.

AUSTRALIAN TARIFFS.—A recent consular report states that the duty on electrical machinery imposed by the commonwealth of Australia is 12½ per cent ad valorem, the same as the duty on engines, gas and water turbines and pumps. The duty imposed by New Zealand on electrical machinery is 10 per cent ad valorem, and 20 per cent on steam, gas and oil engines. In both cases there is a preferential rate in favor of Great Britain.

GAS ENGINE FACTORY.—It is stated from Sharon, Pa., that a large gas engine plant, in which H. C. Frick, of Pittsburg, and George H. Boyd, president of the West Ingot Mold Foundry, are interested, will be built in Sharon. The company has made application for a state charter and is capitalized at $250,000. It will employ 400 men. No engines under 100 hp will be built.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was irregular and drooping in its tendencies. It was a broken week owing to the holiday on Friday and the closing of the exchange on Saturday. There were no particular adverse developments. One of the notable happenings was the placing of a large bond issue by the New Haven Railroad in the Paris market, which was distinctly favorable. On the other hand, the unexpected announcement that the Pennsylvania Railroad had just sold $60,000,000 more notes was for a time the basis of adverse comment and sentiment. The Gould stocks, which had shown a rather steadier tendency at the end of the week previous, were again subjected to some pressure, there being vague unfavorable reports about the Wabash and other lines of that system. On the whole, the market presented the appearance of having been subjected to a pressure of short selling rather than of any general liquidation. There was general dullness among the electrical securities and all closed the week at lower quotations. Except for general efforts at liquidation, there was not much feature to the outside security market. This was most apparent in mining issues. While some stocks closed a little higher, fully as many showed losses compared with the previous week. There was a good deal of selling pressure in Chicago Subway. Following are the closing quotations of Feb. 26:

NEW YORK

	Feb. 19	Feb. 26		Feb. 19	Feb. 26
Allis-Chalmers Co.	14	12⅜	General Electric	158⅛	157
Allis-Chalmers Co. pfd.	36	34½	Hudson River Tel.	...	...
American Dist. Tel	...	...	Interborough Met. Com.	34	33¾
American Locomotive	73¼	72¼	Interborough Met. pfd.	70⅝	70¼
American Locomotive pfd.	111	111	Mackay Cos.	...	...
American Tel. & Cable	83	83	Mackay Cos. pfd.	...	...
American Tel & Tel.	...	...	Marconi Tel	...	...
Brooklyn Rapid Transit	73¾	71⅜	Metropolitan St. Ry.	...	...
Electric Boat	36	30	N. Y. & N. J. Tel.	...	...
Electric Boat pfd.	83	...	Western Union Tel.	82⅛	81⅞
Electric Vehicle	...	...	Westinghouse com.	150	150½
Electric Vehicle pfd	...	...	Westinghouse pfd.	...	...

BOSTON

	Feb. 19	Feb. 26		Feb. 19	Feb.
American Tel & Tel	128⅛	126	Mass. Elec. Ry. pfd	67	68
Cumberland Telephone	...	109	Mexican Telephone	...	4
Edison Elec. Illum.	...	224	New England Telephone	122	122
General Electric	159	156⅞	Western Tel. & Tel.	8	...
Mass. Elec. Ry.	19	19	Western Tel. & Tel. pfd.	77⅛	...

PHILADELPHIA

	Feb. 19	Feb. 26		Feb. 19	Feb. 26
American Railways	...	50½	Phila. Electric	...	8
Elec. Co. of America	...	10	Phila. Rapid Trans	...	20⅛
Elec. Storage Battery	...	60	Phila. Traction	...	93⅞
Elec. Storage Battery pfd.	..	...			

CHICAGO

	Feb. 19	Feb. 26		Feb. 19	Feb. 26
Chicago City Ry.	150	150	National Carbon	80	80
Chicago Edison	...	..	National Carbon pfd.	116¼	115
Chicago Subway	28	25	Union Traction	...	...
Chicago Tel. Co.	...	...	Union Traction pfd.	...	...
Metropolitan Elev com.	25	25			

*Ex-dividend

GENERAL ELECTRIC OUTPUT.—In a review of the company's financial condition, the *Wall Street Journal* says: "It is estimated that the General Electric Co. in the current fiscal year, will do a gross business of upward of $70,000,000, as compared with approximately $58,000,000 in the fiscal year ended January 31 last. This year's business will establish another new high record unless something now unforeseen occurs to interrupt the company's prosperity. The ratio of the company's earnings to gross business in the current fiscal year is expected to be much greater than in the preceding year. Earnings will probably be in the neighborhood of $13,000,000, as compared with earnings of about $10,800,000 in the fiscal year ended January 31 last. Since the first of the year the new business received has been in excess of the corresponding period of the last year. Many old contracts have been worked off, and the company will receive a wider margin of profit as a result. It is understood that the General Electric Co. will not be in the market as a purchaser of copper at prevailing prices for several months, due to the fact that it accumulated supplies when copper was selling below 18 cents. The General Electric Co. has, in fact, purchased no copper above 18 cents. However, a representative of the company is of the opinion that there will be no reaction in copper prices this year, due to the heavy increase in consumption with no corresponding increase in production. The General Electric Co. closed the last fiscal year with a surplus estimated at nearly $17,500,000. If earnings this year are as large as expected, its surplus on January 31, 1908, will be close to $25,000,000. The earnings of the General Electric Co. in the current fiscal year, based on $13,000,000, would be equivalent to about 19 per cent on the outstanding capital of $65,217,200."

PHILADELPHIA BELL.—The Bell Telephone Company, of Philadelphia, has issued its full report for the year ended December 31 last, which shows increases as follows: Gross, $1,066,916; net, after expenses, charges, etc., $390,112; dividends, $342,352; profit and loss surplus, $47,759. The income account compares as follows:

	1906.	1905.	1904.
Gross	$5,501,313	$4,434,397	$3,756,059
Expenses, charges, etc.	3,832,639	3,155,835	2,810,803
Net	$1,668,674	$1,278,562	$945,256
Dividends	1,241,421	899,068	836,010
Profit and loss surplus	$427,254	$379,494	$109,246

This net item, after expenses, of $1,668,674, represents 7.29 per cent earned on the $22,878,433 capital stock. During the year the assets increased from $19,063,867 to $26,421,633, and the surplus from $841,240 to $1,268,494, while the cash on hand was reduced from $427,712 to $108,081. To meet the rapidly increasing demand for service, large additions to the plant were made during the year. Twelve buildings, specially designed and fitted for the purpose of the company, were completed, nine of which were put into service. The remaining three will be put into service early in 1907. The investment in real estate amounted at the close of the year to $2,412,164. In providing additional line plant at exchange centers underground construction was adopted as far as practicable. No less that 771 miles of underground ducts were added to the exchange systems in 1906, 390 miles being added in Philadelphia, and 381 miles in other parts of the territory. In connection with this work 4,100 manholes were built. In the various underground exchange networks there were at the end of the year 2,620 miles of underground duct and 13,400 manholes. There were added to the underground cable plant 1,821,500 feet of cables, bringing the total of such cables at the end of the year to 5,875,000 feet. These underground cables contained an aggregate of 242,600 miles of wire.

MASSACHUSETTS LIGHTING.—In the annual report of the Massachusetts Lighting Companies, President Arthur E. Child says: "Sales of the operating companies show an increase in 1906 of 25 per cent in the gas and 9 per cent in the electric departments. During the year two of the subsidiary companies reduced their rates to customers, but the resulting volume of business in each case has more than offset the lessened rates. The trustees have caused to be issued during 1906, 1,945 additional shares of stock with the proceeds whereof they have purchased a majority of the capital stock of the Leominster Gas Light Company and the Worcester County Gas Company. At the close of the year your trustees held an option to purchase a majority of the stock of the Northampton Electric Lighting Company, and have since purchased under the option nearly all the capital stock of the company. Over 90 per cent of the stock of the Light, Heat & Power Corporation has been purchased, and as a result the Massachusetts Lighting Companies will derive benefits incidental to owning its own construction company. Operations show profits for dividends of 6½ per cent against which 5 per cent has been paid during the year." The gross sales of gas, etc., were $134,443 and of electricity $129,341.

THE BIG TELEPHONE DEAL.—According to advices from that city the St. Louis holders of the securities of the United States Independent Telephone Company, of Rochester, N. Y., have virtually decided to accept the proposition to buy in the company's bonds and stock made by the New Jersey Title Guaranty & Trust Company, understood to be acting for the Bell Telephone interests. The statement that the St. Louisans interested will accept the offer of $350 for the bonds and $5 a share for the common stock, although they lose heavily by the deal, is confirmed through several sources. No formal agreement has been signed here as yet, but the brokers interested say they have assurances that inside of the next few days practically all of the bondholders will sign acceptances of the offer as individuals. This will close the St. Louis end of the deal. About 15 per cent of the company's securities are held in St. Louis, the other 85 per cent being owned in the east, principally in Rochester. The amount of bonds subscribed here was approximately $1,850,000 out of a total issue of $13,500,000. The common stock was given with the bonds as a bonus, four shares of stock with each $1,000 bond. The bonds were sold at par a little over a year ago, and the deal entails a loss to the St. Louis contingent of over $1,000,000, or about two-thirds of their investment. The bonds were sold here almost exclusively to capitalists and wealthy business men who took them in large blocks. There were a few small investors, but not many. Among the St. Louis holders of the securities are: Adolphus Busch, the William F. Nolker heirs, William D. Orthwein, Walter Orthwein, Henry Nicolaus, Breckinridge Jones, August Gehner and George M. Wright.

MEXICAN LIGHT & POWER.—The annual report of the Mexican Light & Power Company shows gross earnings of $3,854,194; operating expenses, $1,476,609; net earnings, Mexican currency, $2,377,219; net earnings, gold, $1,188,609. The company, out of its net earnings of $1,188,609 gold, applied $113,323 gold for the maintenance of its plants, and carried the balance of $1,075,283 gold to profit and loss. The operating expenses of $1,476,975, Mexican currency, include $581,504, which was the cost of steam power during the year pending the completion of the hydraulic plant. The net earnings fell $97,391 gold below the estimates for the year. The general balance sheet shows assets of $28,661,360.05, of which the chief items are: Properties, franchises, concessions, $24,350,456.46, and 60,000 Mexican Electric Light Company, $3,000,000. The profit and loss account shows the following items:

Dividend from Mexican Electric Works	$282,000.00
Dividend from the Mexican Electric Light Co.	140,000.00
Net earnings for 1905, including earnings of properties acquired	380,331.23
Net earnings for 1906 from all properties	1,075,617.85
Total	$1,887,617.85

Against this total is charged the following:

Proportion of interest on bonds chargeable to operating account to Dec. 31, 1906	$518,443.57
The interest on bonds of Mexican Electric Light Co., Ltd., for the year 1906	300,000.00
Uncollectable amounts written off	18,745.85
Total	$837,189.42
Balance	$1,050,428.43

HUDSON RIVER TELEPHONE.—The annual report of the Hudson River Telephone Co. during the last calendar year showed a moderate gain in gross earnings and a decrease in net profits. As the company's interest charges last year were also larger than those of the previous year and dividend disbursements were also a trifle larger, the deficit for 1906 was even greater than that for 1905. The total surplus also showed a considerable decrease. Gross earnings for 1906 aggregated $1,199,679, an increase of $180,682; expenses amounted to $937,897, an increase of $182,014, and net earnings involved $261,782, a decrease of $1,332. Interest charges amounted to $90,366, an increase of $13,413, making the surplus before deducting dividend disbursements, $171,416, a decrease of $14,745. Dividends amounted to $234,594, an increase of $111, making a deficit of $63,178, or $14,856 more than that at the close of 1905. The total surplus aggregated only $205,169, a decrease of $63,178. The company's balance sheet as of December 31, 1906, shows assets of $8,605,606, including contracts and licenses, construction, supply department, real estate, stocks and bonds, accounts receivable and cash. The company reports that seven new exchanges were opened last year and four exchanges completely equipped with new common battery apparatus. At the close of last year, moreover, new common battery apparatus was in process of installation at four other exchanges. Additions were also made last year to the equipments at 11 other offices. The company reported a total of 40,712 stations in service, a gain of 8.1 per cent.

THE CAR CONSOLIDATION.—Official announcement is made in a circular just issued under date of Feb. 6, 1907, of the changes in the Brill Car Company which were noted in these pages last August. J. G. Brill Company has sold and transferred its property and business to the J. G. Brill Company, capital $10,000,000, of which one-half is preferred and one-half common stock. The new company has assumed all of the obligations and contracts of J. G. Brill Company and has become owner of the entire capital stock of the American Car Company in St. Louis, Mo., the G. C. Kuhlman Car Company, Cleveland, O., and the John Stephenson Company, Elizabeth, N. J. The officers of the J. G. Brill Company are: President, James Rawle; vice-president, John A. Brill; second vice-president and general manager, Samuel M. Curwen; treasurer, Edward Brill; secretary, M. Herman Brill; assistant treasurer, Edward P. Rawle; assistant secretary and manager of sale department, Wm. H. Heulings, Jr.; superintendent, R. B. Liddell; assistant superintendent, W. A. Downey; secretary to the president, J. W. Rawle. There will be no present offer of securities, but it is understood that they will be listed on the Philadelphia exchange later. The company is doing a large and profitable business, chiefly in the electric and street railway field.

NEBRASKA TELEPHONE ANNUAL.—The Nebraska Telephone Company has issued its annual report for the year ended December 31, 1906. The income account compares as follows:

	1906.	1905.	1904.	1903.
Gross	1,574,668	1,361,157	1,166,415	1,049,907
Exp.	1,300,367	1,084,559	906.435	857,311
Net	274,301	276,598	259,980	192,596

At the close of the year 1906 the Nebraska Telephone Company had 162 exchanges, a total of 44,517 subscribers' stations, an increase over 1905 of 8,346. In addition, the company has connections by sub-license contract with 36,131 subscribers of independent telephone companies. In 1906, 944,342 feet of underground conduit was laid, 97,780 feet of underground cable was pulled in and 1,238,726 feet of aerial cable was strung. During the year expenditures for construction amounted to $1,039,404, making the total amount in the construction account $4,625,567. Reserve for maintenance amounts to $231,973, investment in buildings and grounds amounted to $347,638, and the debt after deducting cash on hand and bills receivable was, on December 31, 1906, $1,043,084. The company has no bonded debt.

WIRELESS CONSOLIDATION.—The Philadelphia *Ledger* of February 22 says: "Under the title of the United Wireless Telegraph Company, the two wireless telegraph systems now in successful operation in this country and Europe—the American De Forest and the Marconi—will soon be merged. Dr. Lee De Forest, inventor of the system which bears his name, made this announcement last night, following an address before the Franklin Institute on "Recent Developments in Wireless Telegraphy." He said that efforts to merge the companies operating the two systems have been going on for some time, and that he believed it was only a matter of a short time when the plan would be accomplished. Abraham White, president of the American de Forest, is financing the scheme. The United Wireless will be capitalized at $20,000,000, or the combined capitalization of the two companies. The American De Forest is capitalized at $15,000,000 and the Marconi company at $5,000,000. The only difficulty of accomplishing a merger without any delay is declared to be due to the widely scattered ownership of Marconi stock. About $1,000,000 of the stock is now controlled by the De Forest interests."

PEEKSKILL LIGHTING.—The Peekskill Lighting & Railroad Company shows as follows for 1906:

	1906.	1905.		
Gross	$146,503	$125,039	Inc.	$21,464
Expenses	78,172	69,434	Inc.	8,738
Net	$68,331	$55,605	Inc.	$12,726
Charges	37,750	37,750		.....
Surplus	$30.581	$17,855	Inc.	$12,726

The January gross was $12,639, a gain of $2,429, and the gain in net was $1,175.

NIAGARA POWER DEAL.—It is announced from Hamilton, Ont., that the new Dominion Power & Transmission Company with a capital of $25,000,000 will take over the Hamilton Cataract Power, Light & Traction Company, in which Mr. Frederic Nicholls is largely interested. All the Hamilton properties are thus taken over except the Hamilton Street Railway. Holders of common stock in the Cataract company receive three shares of limited preferred stock in the Dominion company for every share of Cataract stock. This stock will be preferred for five years only, after which it will become common. The last Hamilton Cataract report showed that the gross earnings for the year from the power and light, traction companies and other sources, amounted to $1,039,341.87, and the surplus carried to profit and loss was $259,412.82. The balance on hand was $262,512.02. During the year two dividends on preferred stock had been paid, amounting to $166,969.75, and on common stock two dividends amounting to $56,000. A final staement showed assets of $9,255,350.

SALE AT MICHIGAN CITY.—The Michigan City Electric Light & Power Company's plant at Michigan City, Ind., has been purchased by Mr. Clarence H. Geist, now a resident of Philadelphia. He is president of the South Shore Gas & Electric Company, which owns the plants at Hammond, East Chicago, Indiana Harbor and Whiting; he is president of the Valparaiso Lighting Company which owns the plant at Valparaiso; he is president of the South Bend & Mishawaka Gas & Power Company and owns also the gas plant at Lansing, Mich. In addition to these Western holdings he is also interested very largely in the holdings of 18 gas and electric companies in as many different towns in Pennsylvania. The price paid is said to have been about $150,000. Mr. Geist is already the owner of the local gas works and the two plants will now go under the one management, from which Messrs. Boyd & Garrettson will retire. The new concern will be known as the Michigan City Gas & Electric Company.

WOONSOCKET LIGHTING.—The Woonsocket Machine & Power Company is being bid for by two separate interests. The Woonsocket Gas Company, through President F. E. Holden, has offered $140 a share. The other interest, it is said, is the North American Company. Up to a few months ago the capital stock of the Woonsocket Machine & Power Company that had been issued amounted to $400,000. Recently $100,000 in treasury stock was sold to stockholders. In addition to its capital stock, upon which 6 per cent dividends are paid, the company has $350,000 out in 4½ per cent bonds. It also has an indebtedness of about $100,000. It owns the electric lighting business in Woonsocket and Franklin, a business block on Main Street in Woonsocket, a Main Street station, a big electric light and power plant and several mill buildings on Front Street. It also has considerable tenement property and land in the First Ward and owns its old brick station on Bernon Street, which is now used as a dyeing plant.

CHESAPEAKE & POTOMAC.—The Chesapeake & Potomac Telephone Company, which is controlled by the American Telephone & Telegraph Company, has issued its annual report for the year ended December 31, 1906, as follows:

	1906.	1905.	1904.	1903.
Gross	$2,452,076	$1,953,735	$1,468,644	$1,263,831
Expenses	2,010,978	1,611,705	1,450,815	1,076,436
Net	$441,098	$342,030	$17,829	$187,394
Interest	366,416	281,169	232,053	184,752
Balance	$75,681	$60.861	*$214,224	$2,642

* Deficit.

The gain in telephones in Baltimore and Washington was 17,547, the total in service on December 31, 1906, being 70,167 against 52,620 on December 31, 1905. The directors have appropriated $2,100,000 for extensions and additions during 1907.

TELEPHONY IN PITTSBURG.—The annual report of the Central District & Printing Telegraph Company for the year ended December 31, 1906, has been issued. The income account compares as follows:

	1906.	1905.	1904.
Gross	$3,901,310	$3,372,292	$3,055,433
Expenses	2,948,558	2,469,821	2,154,889
Net	$952,752	$902.471	$900,544
Dividends	860,000	800,000	800,000
Surplus	$92,752	$102,471	$100,544

The net shows 8.65 per cent earned on the $11,000,000 capital stock. The report shows a total of 21,873 new subscribers secured during the year, and for the same period more than 150,000,000 messages were handled. On December 31, 1906, the company was operating 104,611 stations.

CINCINNATI VOTING TRUST.—In order to form a voting trust the stock of the Union Gas & Electric Company of Cincinnati has been placed in the hands of the Cincinnati Securities Company, organized for that purpose, and in turn 80,000 out of 100,000 shares of the common stock has been deposited by the company with the Commercial Trust Company of New Jersey, with irrevocable power of attorney. The Cincinnati Securities Company retains all authority incident to the ownership of the stock of the Union Gas & Electric Company and may exercise it as it sees fit. This stock may also be sold or traded in by means of certificates. The agreement is to continue from October 1, 1906 to October 1, 1911, and the control of the stock is the same as when deposited in any other way to be voted by a committee.

INTERNATIONAL TELEPHONE.—A special dispatch from Allentown, Pa., of February 20 says: "A committee of the International Telephone Association held a meeting in this city to-day and arranged for the purchase of the United States Independent Telephone Company's properties. The United States Company owns exchanges in Rochester, Rome, Jamestown, Syracuse and Utica, N. Y., some lines in Utah, and controls the Stromberg-Carlson telephone manufacturing plant in Chicago. The Purchasing Committee consists of James B. Hoge and E. L. Brailley, of Cleveland; Charles West, of Allentown; Judge Orvis, of Bellefonte, and B. G. Hubbell, of Buffalo. The deal acquiring the United States Company represents an investment of $14,000,000."

THE WATERBURY COMPANY.—The stock of the Waterbury Company has advanced steadily, says the *Wall Street Journal*, since it was placed on the curb, January 14. It sold at 37⅝ when first traded in. Recently it sold above 53. This advance is attributed largely to good earnings and the limited supply of floating stock, but it has also been subject to manipulation. The company is a West Virginia holding corporation with a capitalization of $2,500,000 common stock, all issued. This company controls the Waterbury Company of New Jersey, which company conducts the manufacturing business, which includes the manufacture of rubber insulated wire, steel wire, wire rope, fibre rope and copper cables.

MILWAUKEE BONDS.—Spencer Trask & Co. and N. W. Harris & Co. are offering jointly $1,000,000 Milwaukee Electric Railway & Light Co. refunding and extension mortgage 4½ per cent bonds at 95¾ and interest. The authorized issue of the bonds is $20,000,000, of which $4,000,000 are now outstanding. Of the unissued $16,000,000 bonds, half are reserved to retire at maturity, underlying liens, and half in escrow, to be issued after January 1, 1908, to an amount not exceeding $1,000,000 per year, for extensions, improvements, acquisitions, etc.

CANADIAN BELL CAPITAL.—It is stated from Montreal that the proposed increase of Bell Telephone Company of Canada by $3,700,000 of bonds will bring the total bond issue up to the full limit, $7,500,000, all that is authorized upon the stock capitalization of $10,000,000. As many extensions are projected, it is expected that a further stock issue will shortly be made. The company is now seeking the right to increase its capital up to $30,000,000.

DIVIDENDS.—Directors of the Rochester Railway Co. have declared a regular quarterly dividend of 1 per cent. on the common stock, payable March 1. Directors of the American Graphophone Co. have declared a regular quarterly dividend of 1¼ per cent on the common stock, payable March 15.

BUFFALO BELL TELEPHONE.—Stockholders of the Bell Telephone Company, of Buffalo, have authorized an issue of $1,452,000 additional stock. This stock, which is equal to 20 per cent of the present holdings, will be issued at par to stockholders of record on February 15.

BOSTON EDISON STOCK.—The gas commissioners have authorized the Edison Electric Illuminating Co. of Boston to issue 24,200 shares ($2,420,000) of stock to retire outstanding notes and for additions to plant. The issue price of the stock is fixed at $215 per share.

BELLEVILLE, ILL., EXPANSION.—The Belleville Gas & Electric Company has become the St. Clair County Gas & Electric Company, and its capital has been increased from $350,000 to $3,500,000.

GENERAL NEWS.

Construction News.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company contemplates installing additional machinery in its power house on Powell Avenue A battery of boilers of 6,000 hp, a railway unit of 2,000 kw., and a 750-kw Edison system unit for the electric lighting system will be installed. J. M. Bradley is superintendent of the electric department.

DESMOPOLIS, ALA.—The City Council is considering the question of municipal ownership of the electric lighting plant.

HUNTSVILLE, ALA.—The Huntsville Railway, Light & Power Company has decided to increase the capacity of its power plant at a cost of about $40,000. The new machinery which will be installed will double the capacity of the plant. The company announces that the purpose of doubling the plant is to provide against accidents in the future, but it is generally believed it is the first step toward extending the street railway system.

MOBILE, ALA.—The Mobile Electric Company has received a 1,000-kw General Electric, direct-current generator and a new 1,500-hp, cross-compound Corliss engine. This is the first of the new units that the company expects to install in its plant in the near future. T. K. Jackson, president, states that the company expects to put in another generator of the same type, but it has not yet been ordered. The capacity of the plant will be increased by more than 2,100 kw. The recent and immediate improvements consist of three 500-hp boilers with overhead coal bunkers and automatic stokers; one 1,000-kw direct-connected, direct-current generator; one 1,500-hp, cross-compound Corliss engine, to go with a 1,000-kw generator; one 500-kw turbine generator, moved from the powerhouse of the Mobile Light & Railroad Company, and one 350-kw, direct-current generator; the company has almost doubled the capacity of the plant since taking charge of it.

WARREN, ARIZ.—The contract for the construction of the electric railway to run from Warren township to Bisbee, has been awarded to Haggott, Girand, Smith & Company. The contract includes the construction of the roadbed and laying of the rails, and putting in place the necessary electrical equipment. The work is to be completed and the road in operation by Aug. 15.

NASHVILLE, ARK.—The Nashville municipal light plant is said to be for sale. The company from which the plant was purchased is demanding the remainder of the purchase money and threatens to sell the property unless the payment is met. There is no money in the municipal treasury to pay the debt, and the mortgage may have to be foreclosed. The City Council has appointed a committee to confer with the original owners of the plant and ascertain what kind of a settlement may be made satisfactory to all concerned.

ANAHEIM, CAL.—Work has commenced on the construction of the new water works and electric light plant, which will be located about a half mile from the present plant. New machinery for both the electric light plant and the water works plant will be installed and more than $50,000 will be expended in improving and extending the water mains and lighting system throughout the city.

FORT BRAGG, CAL.—A new dynamo has recently been placed in the plant of the Fort Bragg Electric Company and two new boilers will be installed as soon as received. It is said that the company is contemplating adding another dynamo to the plant to be used in case of emergencies. H. C. Johnson is superintendent.

HOLLYWOOD, CAL.—T. J. Fry, G. C. Van Nest and W. A. Avery, all of Hollywood, are interested in the construction of an electric light plant.

OAKLAND, CAL.—A mortgage has been placed on record whereby the Oakland Traction Company mortgages all its holdings to the Union Trust Company. The mortgage is given to secure a bond issue of $12,000,000, a good share of which will be used to extend the street railway system of the Oakland Traction Company.

PERRIS, CAL.—T. H. Sharless is interested in the construction of water works and an electric light plant here.

SAN DIEGO, CAL.—H. A. Howard has been granted a franchise by the Board of Supervisors to construct and operate a street railway over several streets in this city.

SAN FRANCISCO, CAL.—A meeting of the stockholders of the Big Creek Light & Power Company will be held April 23 to vote on the proposition of creating a bonded indebtedness of $359,000. Leo H. Susman is secretary.

SAN RAFAEL, CAL.—The San Rafael Gas & Electric Company has decided to install a sub-station at the power house of the North Shore, near the Alto station, to improve the service of the company in Southern Marin. Wallace Foster is the local manager.

YREKA, CAL.—The Yreka Electric Light & Power Company is enlarging its station to enable the company to distribute about 800 hp in Yreka and Scott Valley from Fall Creek, and 500 hp from the Shasta River plant.

YREKA, CAL.—The Siskiyou Power Company has coupled up its new power plant on Shasta River with its old power house on Fall Creek, and now can furnish electricity for power and light to any point in the territory covered by its lines. The Fall Creek plant is 25 miles from Yreka. The power house on Shasta River is only five miles distant.

DENVER, COLO.—The Denver Gas & Electric Company has placed an order for a new steam turbine, which will be installed in the West Side plant, and will be in operation by Sept. 1.

DENVER, COLO.—The Colorado Telephone Company is contemplating extensive improvements in Colorado during 1907 for extensions, new buildings and new equipment, which will involve an expenditure of $1,500,000.

KENT, CONN.—The Stanley Works, of New Britain, have purchased the plant of the Kent Furnace Company, for the purpose of securing its water privileges on Housatonic River, on which it proposes to establish a power station to generate electricity.

NEW HAVEN, CONN.—The efficiency committee of the board of directors of the New Haven Business Men's Association has been instructed to ascertain what rates are being charged for electricity for light and power in other cities outside of New Haven, and to make a report at the next meeting of the board. The committee consists of Col. George D. Post, C. E. Hart, F. D. Street, Levi T. Snow and Samuel H. Kirby.

NEW MILFORD, CONN.—Work on the power plant to be erected at Boardman's bridge, two miles north of here, has been held up owing to a change of ownership of the New Milford Power Company. The plans of the engineers included the construction of a plant that would generate about 6,000 hp and a dam that would give a waterfall of 60 feet. It is estimated that about $650,000 would be necessary to complete this work. Since it was purchased by the Consolidated Railway Company the work had been held up until the company is satisfied that it will prove a success financially.

OAKVILLE, CONN.—The Baird Machine Company will install an electric plant to furnish electricity to operate its works.

TORRINGTON, CONN.—The Torrington Electric Light Company has purchased a site on Treat Street to provide for the extension of its plant in the future. A new boiler is being installed which will nearly double the capacity of the plant.

WILMINGTON, DEL.—Theodore A. Leisen, chief engineer water department, has prepared plans for utilizing the power in the water which is to run by gravity from the New Porter reservoir to Cool Spring reservoir, a fall of 105 ft., so as to pump with it all the water required for Rockford tower, which comprises part of the high pressure service, and to furnish 140 arc lamps besides; the cost of installing a power plant is estimated at $6,000 or $7,000.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until March 12, to furnish at the navy yards, etc., Portsmouth, N. H., Boston, Mass., Newport, R. I., New York, N. Y., League Island, Pa., Annapolis, Md., Washington, D. C., and Norfolk, Va., a quantity of naval supplies, as follows: Schedule 431—rubber-covered cable, electrical supplies. Schedule 436—voltmeters, marble panels. Schedule 441—speed lathe, trolleys, etc. Schedule 444—conduit, voltmeter, electrical supplies, etc. Schedule 446—aluminum, rolled bronze, brass tubing. Applications for proposals should designate the schedules desired by number. E. B. Rogers, Paymaster General, U. S. N.

ARLINGTON, GA.—Bids will be received until Mar. 5, for $25,000 water works and electric light bonds. J. O. McNeil is clerk of the Town Council.

BAINBRIDGE, GA.—The managers of the municipal electric lighting plant have decided to abolish the flat rate system and will install meters in both electric lighting and water works systems.

COLLEGE PARK, GA.—The City Council is considering the question of employing an engineer to prepare plans and estimates for water works, sewers and an electric light plant. An election will be held to vote on the question of issuing bonds for the same.

FLOVILLE, GA.—W. T. Smith and associates have petitioned for a charter to install an electric plant for lighting the town and running electric cars to Indian Spring.

BETAHLTO, ILL.—The Star Telephone & Telegraph Company has filed a certificate of increase in capital stock.

CARMI, ILL.—The City Council has granted a 50-year franchise to the White County Telephone Company. The capital stock of the company will be immediately increased from $9,000 to $25,000. A new building will be erected and a new switchboard installed.

CHICAGO, ILL.—A permit has been granted to Armour & Company for the erection of a power house in the stock yards at a cost of $130,000.

HANNIBAL, ILL.—The Central Union Telephone Company is planning improvements and extensions to its system, which will involve an expenditure of $36,000.

MARSHALL, ILL.—The Cleveland, Cincinnati, Chicago & St. Louis Railway is installing a new electric plant between West York and Hutsonville, which will cost about $15,000.

PEORIA, ILL.—Municipal control and regulation of gas and electric service and rates is favored by the retail merchants of Illinois. A resolution asking legislation to that end submitted recently to the State convention received almost unanimous approval.

COLUMBUS, IND.—The Columbus Light Company is asking the city for an extension of its franchise so as to enable it to issue bonds to cover cost of extensive improvements contemplated.

FORT WAYNE, IND.—It is announced that the financing of the Fort Wayne & South Bend Traction line has been accomplished, and the organization of a construction company is now under way. A syndicate headed by H. L. Turner has agreed to finance the road.

INDIANAPOLIS, IND.—A bill has passed one branch of the Indiana Legislature which provides that electric light companies may buy rights of hydraulic power companies within or without the State.

NEW CASTLE, IND.—E. M. Carr, superintendent New Castle Heat, Light & Power Company, writes that about $100,000 will be expended in improvements, including a fuel gas plant, piping, etc., and the installation of two generators having a combined capacity of 500 kw; also a boiler of 500 hp.

CARROLL, IA.—Addison Brown has secured control of the Carroll Electric Light, Heat & Power Company. Mr. Brown originally built the plant.

BELLEVILLE, KAN.—Electric light bonds to the amount of $200,000 have been sold.

PARSONS, KAN.—Work has commenced on the construction of an electric light plant which will furnish electricity for lighting the yards of the Missouri, Kansas & Texas Railway yards in this place. The plant will have a capacity of 400 kw when completed.

OWENSBORO, KY.—The Owensboro Street Railway Company has increased its capital stock from $50,000 to $150,000.

ALEXANDRIA, LA.—The citizens have voted to issue bonds, $2,000 of which will be used for extensions to the electric lighting plant.

AUGUSTA, ME.—A transfer was made on Feb. 18 of the Augusta, Winthrop & Gardiner Street Railway Company to a syndicate headed by John Graham, of Bangor. The new owners of the railway system contemplate the construction of an extension to Waterville and also to connect with Lewiston, Brunswick & Bath Street Railway at Sabattus in the spring. The new company organized with John R. Graham, of Bangor, president; Frank Sillaman, Jr., of Scranton, Pa., vice-president; D. F. Hahn, of Lewiston, treasurer.

ELLSWORTH, ME.—J. A. Leonard, of Ellsworth, chief engineer Bar Harbor & Union River Power Company, writes that the Ambursen Hydraulic Construction Company, of Boston, Mass., has secured the contract for constructing the dam. The initial installation of the proposed plant is 2,500 hp, with a possible future extension to 10,000 hp. Sellers & Rippey, Stephen Girard Building, Philadelphia, Pa., are the consulting engineers.

HARRISON, ME.—A movement to incorporate the village of Harrison, in order to establish a municipal lighting plant, has been abandoned. At a meeting of the citizens held to vote on the project the proposition was defeated.

STRONG, ME.—Application has been made to the State Legislature for permission to incorporate the Strong Lighting & Improvement Company. The incorporators are Menzor A. Will, Fred H. Daggart, B. D. Stubbs and C. D. Waldron. The capital stock is placed at $10,000 with the privilege to increase it to a sum not exceeding $100,000.

AYER, MASS.—The Massachusetts Lighting Companies have purchased the entire capital stock and securities of the Ayer Electric Light Company. It is planned to make this company one of the auxiliaries of the large central station to be erected at Still River in the town of Harvard, which will also furnish electricity for the Clinton Gas Light Company and the Leominster Electric Light & Power Company, also owned by the Massachusetts Lighting Companies.

HOLYOKE, MASS.—An order has been adopted by the Board of Aldermen authorizing the issuing of $35,000 in bonds for the gas and electric department for the laying of pipes and mains, the purchase of a turbo-generator set.

MERRIMAC, MASS.—When the new transforming station to be erected by the Merrimac Valley Electric Company at Ring's Island is completed, the power station at the foot of Jefferson Street is to be abandoned, except for use in emergencies. All the cars of both the Haverhill & Amesbury and Citizens lines will be operated by electric energy from the Portsmouth station. It is probable, however, that these changes will not be completed till well into the summer.

NORWOOD, MASS.—The town of Norwood has entered into a seven-year contract with the Edison Electric Illuminating Company of Boston, by which the latter is to supply the township with electricity for public and commercial use. On August 1 the street gas lamps of the town will be replaced by electric lamps while electricity for commercial light and power will be furnished as soon as practicable.

CASS CITY, MICH.—The Cass City Telephone Company has completed arrangements for the installation of an independent system.

CRYSTAL FALLS, MICH.—The Common Council is now considering the proposition to enlarge the city electric plant.

DETROIT, MICH.—The budget of the Public Lighting Commission of 1907 shows an increase of $192,039 over that of 1906 and includes $25,092 for 110 arc lamps to replace Woodmere gas lamps, $22,800 for installing overhead wires and lamps and $9,800 for seven automatic stokers, etc.

HANCOCK, MICH.—The Board of Public Works is securing estimates for of the cost of a municipal lighting plant.

NEGAUNEE, MICH.—The Board of Public Works is contemplating the enlargement of the power house of the municipal electric light plant and about two miles of line extension. H. T. Pearce is superintendent.

NEWBERRY, MICH.—The citizens are contemplating installing a new boiler in the municipal electric lighting plant. S. R. Sprague is superintendent.

ST. LOUIS, MICH.—The managers of the municipal electric light plant are preparing to change the system from direct to alternating current. J. W. Seaman is superintendent.

TRAVERSE CITY, MICH.—William Louden, manager of the Boardman River Electric Light & Power Company, writes that the company expects to raise the head of one of its dams during the coming year.

VASSAR, MICH.—The citizens are considering the question of installing a new 200-hp engine in the municipal electric lighting plant. Walter Peck is manager.

WILLIAMSTOWN, MICH.—The Williamstown Illuminating Company is planning to install a new boiler in its plant next year. C. H. Vaughan is manager.

AITKIN, MINN.—Dr. C. S. Kathan, of Aitkin, will construct a power plant here, to cost about $25,000.

ALDEN, MINN.—The W. W. Walker Milling Company has under consideration the purchase of an accumulator plant. W. W. Walker is manager.

CLARKFIELD, MINN.—The Clarkfield Roller Mills & Electric Light Company is considering the question of enlarging its electric plant and will install a larger generator, engine and switchboard. G. H. Ledbetter is manager.

DAWSON, MINN.—The Village Recorder writes that it is proposed to construct water works and an electric light plant at a cost of $28,000. James O'Hara is engineer.

FAIRMONT, MINN.—We have been informed that the municipal electric light plant will be rebuilt and its capacity greatly increased. The machinery and equipment have not yet been decided upon. Alfred Horne is manager.

LAKE CITY, MINN.—A new boiler of 200 hp will be installed in the municipal electric light plant, and possibly a 150-kw dynamo and engine. E. V. Lombard is chief electrician.

LUVERNE, MINN.—The Council is considering the establishment of a day power and light service in the near future for the municipal electric light plant. J. H. Hughes is superintendent.

MADISON, MINN.—J. C. Bang, manager of the city electric light plant, writes that the city is figuring on establishing a day service.

MINNEAPOLIS, MINN.—The resolution before the Minneapolis City Council which would deprive the Minneapolis General Electric Company of its existing rights and privileges in the city streets and require it to vacate the public thoroughfares before a fixed date, was approved Feb. 17 by the special council committee to which it was referred. The resolution now stands to be recommended to the council for passage, but the committee will meet again and consider a new form of ordinance to be submitted by the electric company, and it is possible that the former action may be modified in some measure.

SOUTH ST. PAUL, MINN.—The South St. Paul Electric Heat, Light & Power Company is now considering the installation of a direct-connected unit in its plant. E. W. Erick is manager.

HATTIESBURG, MISS.—Edward J. O'Bearne, contracting engineer, Atlanta, Ga., writes that the date of opening of bids which had been set for Mar. 6, for the construction of an electric railway for the Hattiesburg Traction Company, has been indefinitely postponed.

POPLARVILLE, MISS.—The contract for the erection of the power house to be used for the water works and electric light plant has been awarded to W. P. Craft, of Ellisville.

JOPLIN, MO.—The Joplin Light, Power & Water Company has applied for a franchise to lay conduits and string overhead wires for the operating of an electric light and power system.

TRENTON, MO.—The Citizens Gas & Electric Company is now installing a 1,300-kw, three-phase, 2,300-volt generator, engine and boiler in its plant. James T. Carnes is manager.

GREAT FALLS, MONT.—A bill has passed both the Senate and the House of Representatives authorizing the Missouri River Improvement Company, a Montana corporation, to construct a power dam across the Missouri River in Montana below Great Falls.

HELENA, MONT.—The power plant of the Helena Power & Transmission Company, on the Missouri River at Lake Hauser has been completed and is now furnishing electricity for lighting Anaconda and power for the Anaconda street railway system. The company also furnishes electricity for operating the machinery in the Butte mines and Anaconda smelters.

JOLIET, MONT.—David Lay, Engineer of Redlodge, Mont., writes that E. H. Corle, of Joliet, will construct an electric light plant at Joliet, to cost about $15,000. Bids will be wanted about Apr. 1.

LEXINGTON, NEB.—The Lexington Mill & Elevator Company will install a street lighting system at once. Both arc and incandescent lamps will be used.

OSCEOLA, NEB.—Clarence Miller, manager of the Osceola electric light plant, writes that the installation of a new Corliss engine is contemplated also the resetting of a boiler.

BERNARDSVILLE, N. J.—The Bernards Water Company expects to change the system of its electric light plant to 60-cycles, three-phase system in the near future. P. V. Stryker is manager.

NEWARK, N. J.—The special committee appointed to take charge of the work of installing an independent electric light plant in the new city hall, on Feb. 20 appointed James M. Seymour, jr., engineer of the work.

ASBURY PARK, N. J.—The Beach Committee has decided to increase their beach electrical plant by adding a 150-kw dynamo.

ATLANTIC HIGHLANDS, N. J.—The New Jersey Traction Company has made application to the County Board of Chosen Freeholders for a franchise to construct an electric railway at Atlantic Highlands from the pier through the borough to connect with the main line.

ATLANTIC CITY, N. J.—The placing of all the Boardwalk electric light wires in conduits is reported under consideration, and George Gale, chairman Electrical Committee of the City Council, has been authorized to engage an engineer to prepare plans and supervise the proposed work.

ELIZABETH, N. J.—The Public Service Corporation has submitted a proposition to the City Council to supply 260 arc lamps for two years at a cost of $77.50 each a year. This is a reduction of $15 from last year's rates. No action has been taken on the proposition.

WASHINGTON, N. J.—The Washington Electric Company is contemplating the reconstruction of its lines in the spring. Thomas W. Haldman is manager.

LAS CRUCES, N. M.—The Las Cruces Electric Light & Ice Company will install a new boiler this coming spring, and also a new engine for day service. B. L. Berkey is manager.

SANTA FE, N. M.—A bill has been introduced in the Legislature asking for an appropriation of $20,000 for an electric light plant at the territorial penitentiary.

TUCUMCARI, N. M.—The Tucumcari Water, Ice & Power Company is planning to install a water works system and ice factory in connection with the electric light plant. The company has a 50-year franchise. L. E. Taylor is manager.

BUFFALO, N. Y.—Bids will be received until March 5 by the Department Public Works (F. G. Ward, commissioner) for furnishing and delivering f. o. b. factory the following: One 25-hp, four-cycle auto marine engine with four cylinders about 4¼ in. diameter, of the open base, long stroke, jump spark type, complete with carbureter, mechanical oiler, single unit spark coil and distributor, reverse clutch, thrust bearing, one set dry batteries starting handle, one 1¼ in. Tobin bronze shaft 6 ft. long, with a two-blade bronze propeller wheel keyed to same on taper bearing, bronze stuffing box, etc.

BUFFALO, N. Y.—Arrangements are being made for the construction of a single-track railway between Olcott and Batavia, to be known as the Batavia, Medina & Ontario Railway Company. The line will be constructed by the Orleans Construction Company of this city.

CALLICOON, N. Y.—Martin Hermann, president of the Callicoon Electric Light, Heat & Power Company, writes that it is proposed to construct an electric light plant here at a cost of about $10,000. He is not yet ready to receive bids.

DEPOSIT, N. Y.—The Deposit Electric Company is considering the installation of a 250 or 300-hp unit, probably a Corliss engine and an additional boiler, and also another dynamo of 100 kw. Morris Knapp is manager.

DUNDEE, N. Y.—E. L. Bailey, owner of the Dundee electric light plant, writes that he has under consideration the erection of a transmission line to Lakewood, N. Y., and also the construction of an electric railway to North East Railroad, 3½ miles distant.

EASTPORT, N. Y.—It is reported that the Niagara, Lockport & Ontario Power Company will supply electricity for light and power to the village of Eastwood and some of the manufacturing plants in this place.

ELMIRA, N. Y.—Preparations are being made by the Elmira Water, Light & Railroad Company for the installation of a new 1,500-hp Curtis turbo-generator set. To make place for this machine $75,000 worth of machinery is being taken out, which will be disposed of at a great sacrifice. The company is planning to install another unit of the same capacity in its plant for the purpose of furnishing electricity for several electric interurban lines which are now being contemplated.

KINGS PARK, N. Y.—Bids will be received by the State Committee in Lunacy at the State Capitol, Albany (T. E. McGarr, secretary), until March 6, for outside arc lighting system at Kings Park State Hospital, Kings Park, N. Y.

LE ROY, N. Y.—The Le Roy Hydraulic Electric Gas Company is planning to develop its power more fully this summer, and to extend its lines to reach all factories within the city limits. A. R. Tremaine is superintendent.

MACEDON, N. Y.—The Village Board has granted a franchise to the Rochester, Syracuse & Eastern Railway Company to furnish electricity for lighting the streets of the village. C. A. Lux is secretary of the company.

MIDDLEVILLE, N. Y.—The Electric Light Company is planning to build a new power house in the spring and install a 75-kw, 2,300-volt, single-phase, 60-cycle generator belted to a new pair of 27-in horizontal turbines.

OPPENHEIM, N. Y.—The East Creek Electric Light & Power Company, of East Creek, has purchased property here on which it is proposed to construct a dam 111 ft. high across East Canada Creek, in connection with its proposed power house at Inghams Mills.

ROCHESTER, N. Y.—The State Commission of Gas and Electricity on Feb. 25 entered an order that the price of electric energy in Rochester shall be 8 cents per kw hour from Oct. 1, 1907. The price of electric energy at the present time is 10 cents per kw-hour, with one cent discount for prompt payment.

SALAMANCA, N. Y.—A. H. Krieger, manager of the Salamanca Water Works Company, writes that the company will thoroughly overhaul its plant in the spring and will install two 150-hp gas engines.

SHERMAN, N. Y.—The Sherman Electric Light Company is contemplating the purchase of electric meters and other miscellaneous equipment for its plant. C. E. Cobb is manager.

SPRINGVILLE, N. Y.—The managers of the municipal electric light plant are considering the installation of a 75-kw, 60-cycles, single-phase, 2,200-volt generator in the electric light plant. F. H. Brace is superintendent.

SYRACUSE, N. Y.—Assemblyman Hammond, of Syracuse, has introduced a bill in the Assembly reducing the price of gas and electricity in Syracuse. The bill fixes the price for arc lamps at not more than $68 per lamp per year, on an all-night schedule, and the price for incandescents at not more than nine cents per kw-hour prior to October 1, 1907, and eight cents per kw-hour thereafter.

SYRACUSE, N. Y.—The State Commission of Gas and Electricity on Feb. 19 refused to permit the new Onondaga Lighting Company to do business in Syracuse and to lease the existing company's plant in that city. The applications, which have been pending several months, included the issue of stock amounting to a million dollars by the new company and an increase of capital stock of the old company, the Syracuse Lighting Corporation, from four to nine millions. In several respects the commission disapproves of this lease. The disapproval is based generally upon grounds of public policy.

TANNERSVILLE, N. Y.—The Schoharie Light & Power Company will build a 500-hp steam plant as soon as the weather will permit. Cyrus Shoures is manager.

CHARLOTTE, N. C.—The power plant of the Catawba Power Company at Great Falls has been completed and will soon be in operation. The company is now furnishing electric energy in Mt. Holly and connection has been made with the dynamos in the new Woodlawn mill. The Nimms Manufacturing Company has also been connected and both mills will be operated by electricity.

ELIZABETH CITY, N. C.—The Elizabeth City Light & Power Company has been awarded a ten-year contract by the town of Elizabeth City, N. C., for furnishing electricity for lighting purposes. The contract calls for equipment, etc., costing $5,000.

TRYON, N. C.—The Tryon Electric Light & Power Company, recently incorporated, is now engaged developing a water-power on the Pacelot River between Tryon and Melrose, which will afford about 3,000 hp. Electricity will be furnished in Tryon and Saluda. It is also proposed to extend its transmission lines to Spartanburg, S. C., and other towns. Todd Russell is general manager.

CANDO, N. D.—The Cando Electric Light & Telegraph Station is expecting to install another boiler this coming spring. J. C. Rader is owner.

VELVA, N. D.—This city proposes to construct water works, an electric light plant, and make other extensive improvements this coming year. A preliminary survey has been made and the City Council will soon be looking for a competent man to draw plans and specifications and superintend the work. G. N. Livdahl is mayor.

AKRON, OHIO.—Surveys are being made for the construction of the Akron, Alliance & Youngstown Electric Railway. The road will be 60 miles long. B. M. French is engineer in charge.

ARLINGTON, OHIO.—The citizens are considering the proposition of purchasing the electric plant which is now owned by Adam Beach.

ATHENS, OHIO.—It is stated that the municipal electric light plant will be improved at a cost of $6,000.

BRYAN, OHIO.—F. W. Radabaugh, clerk of Council, writes that the citizens voted on Feb. 19 to issue $30,000 in bonds for improving the electric light plant.

CINCINNATI, OHIO.—The Executive Committee of the Union Gas & Electric Company, on Feb. 15, authorized the laying of new conduits, feeder mains and cables in the business district of Cincinnati.

CLEVELAND, OHIO.—Only one bid was received for the Lakewood municipal electric lighting plant. The bidder was the Cleveland Electric Illuminating Company, which offered $76,600 for the plant, providing the Council makes a satisfactory contract with the company for lighting the village. The plant a year ago was inventoried at $57,000, less depreciation. Since that time more machinery and equipment have been added. It is said that while the bid of $76,600 may cover the cost of the machinery and equipment, the plant is worth much more. The plant has a great quantity of copper wire which to-day is worth just twice what it cost the village.

ELYRIA, OHIO.—Councilman Martin Mueller is advocating the establishment of a municipal lighting plant.

MILFORD, OHIO.—A resolution has been adopted by the Council instructing the village solicitor to prepare an ordinance granting a franchise to the Cincinnati, Milford & Loveleand Traction Company to construct and operate an electric light plant in the town.

PAINESVILLE, OHIO.—The City Council has passed an ordinance authorizing the issue of $1,100 in bonds for the purpose of extending and improving the electric light plant.

MARSHFIELD, ORE.—The Coos Bay Gas & Electric Company is making arrangements to construct an electric railway between Marshfield and North Bend. The company recently purchased the electric plant of North Bend and Marshfield, and is improving the properties. Machinery has been ordered for additions to the power stations, while rails, cars and other equipment for the city lines have been contracted for. The first line will be built from North Bend to Marshfield, a distance of four miles. Later a line will be built from Marshfield to Empire, four and one-half miles long.

PORTLAND, ORE.—It is the intention of the officials of the Portland Railway, Light & Power Company to duplicate the Cazadero power plant, and work has been started on the Clackamas River, about two and a half miles above the Cazadero station. The latter will be operated for the first time early in this month. The new plant will have a capacity of 25,000 hp, and will cost $750,000. Plans for the station are complete and as soon as the surveys are finished work will be commenced. It is estimated four years will be required to complete it.

ROSEBURG, ORE.—At a meeting of the City Council held Feb. 6, Mayor Hoover in his message to the Council advocated municipal ownership of the water and light plants. The plants have changed hands several times in the past few months and the service furnished has been unsatisfactory. The message was approved and adopted by the Council, and later during the session an initiative and referendum ordinance through which the city can own its own water and light systems was read the first and second times.

ALLENTOWN, PA.—At a meeting held Feb. 21 of telephone interests representing $300,000,000 of invested capital, arrangements were made to purchase the property of the United States Independent Telephone Company, of Rochester, at a valuation of something more than $14,000,000. The property includes exchanges at Rochester, Syracuse, Utica, Jamestown and Rome, N. Y., several hundred miles in Utah and a controlling interest in the Stromberg-Carlson Telephone Manufacturing Company, as mentioned elsewhere in this issue.

GREENSBURG, PA.—At a recent meeting of the directors of the Pittsburg, McKeesport & Greensburg Railway Company additional equipment to the amount of $50,000 was authorized. The new equipment will include cars and power house improvements.

HUGHESTOWN, PA.—The Pittston & Avoca Street Railway has petitioned the Borough Council for a franchise to construct and operate a street car line on Parsonage Street, for the length of the borough. It is also stated that the company will soon establish an electric railway between Pittston and Inkerman.

JOHNSTOWN, PA.—Surveys are now being made for the proposed road to connect this city with Westmount. C. S. Price, general manager of the Cambria Steel Company, is interested in the project.

PITTSBURG, PA.—The City Council has passed an ordinance granting the Pittsburg Railways Company a franchise for the construction of a new railway between Wilkinsburg and East Pittsburg.

PITTSBURG, PA.—Westinghouse, Church, Kerr & Company have secured the contract for the power house for the homeopathic group of buildings in Shadyside, and have already begun work on the foundations. The buildings will cost about $22,000.

SOUTH BETHLEHEM, PA.—Electric machinery has been installed to operate the new switch tower of the Lehigh Valley Railroad Company at Wyandotte Street. A gasoline engine is used to operate the plant.

STRASBURG, PA.—The Strasburg Electric Light & Power Company, recently incorporated, has been organized with W. K. Bender, of Strasburg, president; H. S. Hunsecker, of Lime Valley, vice-president, and Levi J. Blair, of Strasburg, secretary and treasurer. The capital of the company is $50,000, and it is said to be the purpose of the company to operate water power plants at Wheatland Mills and Pugh's Mill. The company has the contract to light Quarryville and Strasburg, and expects in the near future to also furnish electricity for lighting for Lampeter, Willow Street and Paradise.

WHITEMARSH, PA.—The Conshohocken Electric Light & Power Company has been granted a 25-year franchise by the township supervisors to erect its wires and furnish electricity for light and power in the town. In payment for the privilege the company agrees to furnish a street lamp of 24 cp for each mile of wire strung in the township. Work will commence on installing the system as soon as the weather will permit.

PROVIDENCE, R. I.—The Rhode Island Company has decided to build the cross-town electric line from Knightsville through Park Avenue to Broad Street in Edgewood.

MORRISTOWN, TENN.—The City Council has appropriated $350,000 for the purchase of machinery and the making of improvements to the electric light and water plants. Jas. Mather is superintendent.

TRENTON, TENN.—The City Council has appointed a committee composed of Dr. T. J. Happel, G. W. Wade and T. E. Harwood, to petition Legislature for the privilege of voting bonds for an electric light plant and other public improvements.

BRENHAM, TEX.—The Navastota-Washington Telephone Company has been granted a 25-year franchise over the public roads from the Washington County line to Brenham by the Board of County Commissioners.

BROWNWOOD, TEX.—The City Council is considering plans for installing a lighting plant for street lighting purposes.

CORPUS CHRISTI, TEX.—The Corpus Christi Ice & Electric Company is contemplating the erection of a new electric and cold storage plant in this place in the near future.

MANSFIELD, TEX.—The Mansfield Telephone Company has increased its capital stock from $16,000 to $25,000.

HOUSTON, TEX.—The Houston Electric Company is making preparation to place its wires underground in this city.

WEATHERFORD, TEX.—The City Council has granted a franchise to G. M. Bowie, of this city, to build and operate an electric street railway in this city. Col. Bowie will apply to the County Commissioners for a franchise for the building of an electric line from Weatherford to Fort Worth.

PROVO, UTAH.—The Telluride Power Company is installing a new water power plant under 1,600-foot head on Battle Creek, west of its present Olmstead station, at the mouth of Provo Canyon. The new plant will be used as a reserve and will be connected with the company's 40,000-volt transmission system, which embraces over 300 miles of line in the Utah Valley. The Telluride Company is also contemplating the erection of a new power plant on the Beaver Creek, near Newhouse.

SALT LAKE CITY, UTAH.—The Mill Creek Power Company, Owen Gray, engineer, has practically completed its water-power plant in Mill Creek Canyon, and as soon as its sub-stations are completed will commence operating. The plant utilizes of head of 600 feet with a Doble water wheel driving a General Electric alternator. Electricity will be transmitted to Murray for light and power.

CAVENDISH, VT.—The Black River Electric Lighting & Power Company has been granted an amendment to its charter by the Vermont Legislature for the right of domain for building dams and flowing land for water purposes on Black River. The company is planning to place a dam at Cavendish Gorge and to construct a power plant having a capacity of 2,000 hp. L. N. Wheelock, of Claremont, N. H., is manager.

HINESBURG, VT.—Daniel Patrick is preparing to install an electric light plant in his mill to furnish electricity for lighting the mills and residences in that part of the town.

NORFOLK, VA.—The Jamestown Exposition Company has contracted with the Norfolk & Portsmouth Traction Company for furnishing electricity to light the exposition grounds. The contract is said to call for 5,000 kw.

NORFOLK, VA.—Bids will be received until Mar. 30 by H. H. Rousseau, Chief of Bureau Yards and Docks, Navy Department, Washington, D. C., for furnishing nine electric capstans and accessories for dry dock No. 3, navy yard, Norfolk, as per specification No. 1526.

CASHMERE, WASH.—The issuing of bonds for the installation of water and electric light systems is under consideration.

PROSSER, WASH.—The Prosser Electric Company, one of the two electric lighting plants operating here, has made an offer to the City Council to sell its plant to the city for $8,500 cash, or for $100 per month on ten years' time, interest included. The offer was referred to the public improvement committee. The other company, the Prosser Falls Land & Power Company, E. F. Benson, president, has recently offered to buy the plant of the Prosser Electric Company.

SEATTLE, WASH.—The Seattle Electric Company is contemplating extending its lines to West Seattle, and will make application to the City Council for a franchise to supply electricity for lighting and power purposes.

SEATTLE, WASH.—The County Commissioners of Kings County have granted a franchise to the Seattle Electric Company for an electric railway from Alki Point around the shore line of Duwamish head to the junction across the waterways.

SOUTH BEND, WASH.—The Board of County Commissioners has granted a franchise to Martin C. Welsh to construct and operate an electric railway over certain streets and public highways in Pacific County. The franchise is for a term of 50 years.

SPOKANE, WASH.—Storage batteries costing over $200,000 have been installed on the Coeur d'Alene and the Spokane & Inland lines, and in connection with these is the transformer station costing $300,000. The company purchases its electricity from the Washington Water Power Company, on a basis of $20 per hp per year for 24 hours' service. To take care of the surplus energy occasioned by light loads on the lines the battery system is employed.

SUNNYSIDE, WASH.—C. M. Scott has applied to the Council for a franchise to establish water and electric light plants. An application has also been presented to the Council by R. G. Page for permission to erect an electric light plant.

TACOMA, WASH.—Improvements costing about $50,000 are contemplated at the lighting plant in the down-town district. Heavy copper wires and larger transformers are to be installed. It is stated that about 150,000 lbs. of copper wire will be required and the cost of this part of the work alone will be about $40,000. A. L. Thorn is city electrician.

TEKOA, WASH.—M. J. Shields, president of the Moscow Light & Power Company, and the committee that has been endeavoring to secure a lower lighting rate for Tekoa, has come to a final agreement and the rate war waging for several weeks is practically settled. The ordinance granting a franchise to residents of Tekoa has been withdrawn by the chairman of the committee.

WENATCHEE, WASH.—A company has been formed in this city by W. T. Clark, Marvin Chase and F. M. Scheble for the purpose of building a large power plant on the Wenatchee River. Articles of incorporation are being prepared and the capital stock is fixed at $100,000.

ASHLAND, WIS.—The City Council has decided to have plans prepared and call for bids for a municipal electric light plant.

BARRON, WIS.—The Barron County Telephone Company has increased its capital stock from $22,500 to $50,000.

PRAIRIE DU SAC, WIS.—A bill has been introduced in the State Legislature by J. S. Tripp, Robt. Buerki, and others, to build a dam across Wisconsin River for power purposes.

MILWAUKEE, WIS.—Arrangements have been made by the Wisconsin Telephone Company to expened $1,500,000 in Milwaukee and the state at large in improving its service. It is the intention, according to President Burt, to complete the conduit system between Chicago and Milwaukee. The conduit has been completed and the company will begin burying the circuits at once. The work laid out for this city will approximate $800,000.

GALGARY, CAN.—The city has decided not to proceed with the proposal to develop power at Kananaskis Falls, but will receive proposals from several prospective power companies. Address Mayor Cameron.

EDMONTON, CAN.—W. H. Cushing, Minister of Public Works, states the Government is prepared to begin at once the construction of municipal telephone systems in every town in the province in addition to the long distance lines now being built by the province.

WINNIPEG, MAN.—R. D. Fletcher and J. A. Munro are interested in the formation of an electric railway now seeking incorporation, which will be built from this city to Lakes Winnipeg and Manitoba.

SACKVILLE, N. B.—The Cove Hydro-Electric Company, of Boston, Mass., is formulating a scheme to buy land in Sackville, with the idea of installing an electric plant for lighting the towns of Sackville, also Dorchester, Memramcook, Moncton, and other places along the line. The company has applied for incorporation papers with a capital of $2,000,000, and the incorporators are as follows: Hampton V. Hayward, president Frank R. Kimball and Geo. H. Cove.

FT. WILLIAM, ONT.—We are informed that the improvements contemplated by the Kaministiquia Power Company, at Ft. William, in connection with the Kakabeka Falls power plant, consist of the construction of 6,500 ft. of 10-ft. concrete flume, and the work will be executed by the company. R. S. Kelsch, Montreal, Que., is consulting engineer.

FORT WILLIAM, ONT.—The Council has decided to spend $26,000 this year in building extensions to the electric light system. Of this amount $5,000 will be spent in new meters, and 12,300 pounds of wire will be required. Address Mayor Routledge.

OTTAWA, CAN.—A civic commission will go to Toronto to interview the Hydro Electric Commission as to the water power available around Ottawa. This is in regard to the probable purchase of the $200,000 plant of the Metropolitan Electric Company at Britannia. The city officials wish to know how the legislation applied for will affect them.

TRENTON, ONT.—The Northumberland-Durham Power Company has decided to develop power at Healy Falls and other water powers on the Trent River.

MONTREAL, CAN.—The Bell Telephone Company of Canada is contemplating an issue of $3,750,000 new bonds.

MONTREAL, QUE.—Rochon & Fils, marble cutters, have closed a contract with the Montreal Light, Heat & Power Company to furnish electricity for operating their plant.

HARBOR GRACE, N. F.—Louis Williams, manager of the Harbor Grace Electric Company, writes that the company has under consideration the erection of 15 miles of transmission lines to supply two more towns with electricity.

CUERNAVACA, MEX.—An electric power plant is to be installed on the Verde River, in the state of Morelos by Ramon Sanchez Valdes.

HIDALGO, MEX.—Alfred Burlon will install a hydro-electric power plant on the Moctezuma River in the state of Hidalgo. The power will be used for operating a number of industrial concerns in that section.

MEXICO CITY, MEX.—Rafael L. Zaldana has made application to to the Federal Government for authority to install a hydro-electric power plant on the San Geronimo River at a point near the town of Resumidero.

MORELIA, MEX.—Felix Rodriguez has taken steps to install a large hydro-electric plant on the Cupatitzio River.

PARRAL, MEX.—The Parral Power & Reduction Company has completed its auxiliary electric power plant of 1,500 hp. It is transmiting the electrical energy to Ninas Nuevas for the operation of mining plants.

Company Elections.

BIRMINGHAM, ALA.—At the annual meeting of the Coosa River Electric Power Company, held recently, the following directors were elected: General R. D. Johnston, W. L. Church, D. K. Miller, R. H. Cobb, Jr., and Roswell H. Cobb. The directors elected the following officers: Roswell H. Cobb, president and manager; General R. D. Johnston, vice-president; D. K. Miller, treasurer; R. H. Cobb, Jr., secretary.

DENVER, COLO.—At the annual meeting of the stockholders of the Colorado Telephone Company held recently the following board of directors was elected: E. B. Field, Philip Feldhauser, A. V. Hunter, Edward S. Kassler, Crawford Hill, W. L. Graham, C. E. Yost, Frederick P. Fish and Edward B. Field, Jr. Alonzo Burt, of Milwaukee, and Joel F. Vaile, of Denver, retired from the board.

OMAHA, NEB.—At the annual meeting of the Nebraska Telephone Company it was decided to increase the capital stock $2,000,000, making the total capitalization $5,000,000. The company spent over $1,000,000 in improvements last year. The following officers were elected: Casper E. Yost, president; H. Vance Lane, vice-president and general manager.

Legal.

AUTHORITY OF PRESIDENT OF CORPORATION TO ENTER INTO VERBAL AGREEMENT.—A by-law of a corporation which provides that it shall be the duty of the president of the corporation to execute in conjunction with the secretary all contracts which may be executed or issued by the corporation does not affect the right of the president to enter into an oral contract for the sale of a quantity of the goods in which the corporation deals. The by-law in question merely referred to the execution of written agreements and had no reference to oral contracts made by the president as manager of the corporation. Freyberg vs. Los Angeles Brewing Company, California Court of Appeal, 88 Pac. Rep. 378.

LIABILITY OF TELEPHONE COMPANY FOR NEGLIGENCE IN DELIVERY OF LONG-DISTANCE MESSAGE.—The plaintiff went to the office of the defendant telephone company and put in a long-distance telephone call for the purpose of ascertaining the state of health of a relative who was dangerously ill. The call was made early in the morning and a messenger's fee was demanded and paid by the plaintiff to get his party to the telephone. The call was received by the company's agent who sent a messenger to notify Burton, the party wanted, that there was a long-distance call for him. The messenger did not report back to the exchange and a second messenger was started out and came back with word that he could not find the party. The first messenger boy, during the afternoon, told the children at the Burton house that some member of the family was wanted at the telephone, and that fact was communicated to Burton about 6 o'clock in the evening. The parties never succeeded in getting into communication and in an action for damages the jury awarded the plaintiff $250. In an appeal taken by the company the court held that the facts did not warrant the granting of punitive damages, or damages by way of punishment. Punitive damages may be recovered only in cases where the acts complained of are characterized by malice, fraud, oppression, or willful wrong, evincing a disregard of the rights of others. While the company had undoubtedly been careless in tending to the delivery of the message, it was considered apparent that there was no intentional or willful wrong. The measure of damages was, therefore, limited to the actual damage suffered. Cumberland Telephone Company vs. Allen Supreme Court of Mississippi, 42 Sou. Rep. 666.

LIABILITY OF TELEPHONE COMPANY FOR DAMAGE CAUSED BY SAGGING GUY WIRE.—The plaintiff, owner of a self-propelling threshing machine, was running it along a public highway in the State of Wisconsin when the elevator of the machine ran against a guy wire of the Clinton Telephone Company and was demolished. The wire had sagged until it was only thirteen feet above the ground and was in such condition that it was often necessary for persons driving loaded wagons along the highway to lift the wire in order to pass. The statutes of Wisconsin, authorizing the construction of telephone lines on public highways, provide that such lines shall not obstruct the public use of the road and require all wires to be strung not less than twenty-four feet above the highway at crossings and not less than fourteen feet at all other places. The telephone company claimed that the plaintiff had no right to recover because of the reason that he had been guilty of negligence contributing to the damage to his machine, and put in a counter claim for damage to its guy wire. There was evidence that the guy wire had been maintained in a sagging condition for over two years; that the attention of the plaintiff was fully occupied in the guiding of the thresher; that the smoke from the engine was being blown in front of him and that he did not see the wire. The court found that the facts did not show contributory negligence on the part of the plaintiff and the telephone company was accordingly held responsible in damages. Chant vs. Clinton Telephone Company, Supreme Court of Wisconsin, 110 N. W. Rep. 423.

RIGHT OF PERSON TRIPPING OVER GUY WIRE TO COLLECT DAMAGES FOR RESULTING INJURIES.—The parties to an action stood in the relation of landlord and tenant to each other, the defendant having leased to the plaintiff premises upon which stood a dwelling house. At the time of the making of the lease there was an electric light pole standing in the street in front of the lot, from the top of which a guy wire was stretched to the ground at a point just inside of the front line of the leased property, where it was fastened to an anchor fixed in the earth. Though the plaintiff was aware of the existence and position of the guy wire, she tripped over it upon leaving the premises in the evening, and was severely injured as a result of falling upon the end or point of the wire which protruded from the ground. In an action for damages brought against the landlord, it was held that the tenant had assumed all risks arising from dangers which were obvious to ordinary observation. With regard to the sharp point protruding from the ground, it was held that, though it might have been there through the negligence of the defendant, the plaintiff was not entitled to recover for the reason that she had by her negligence contributed to the cause of the injury. While the action was not brought against the electric light company which owned the guy wire, there is no apparent reason for a different result if the suit had been so brought. Hatch vs. McCloud River Lumber Company, Supreme Court of California, 88 Pac. Rep. 355.

RISK ASSUMED BY EMPLOYER MAKING USE OF NEW APPLIANCE.—The principle that an employer who, instead of adopting an appliance in common use, makes use of a new appliance not ordinarily employed in the particular work for which it is intended, assumes the risk of the safety of the appliance, is illustrated in a recent Washington decision. The employer used a U-shaped clamp for the purpose of lifting steel plates. The clamp was fastened by placing the end of the plate between the flanges and tightening a set screw in one of the flanges with a wrench, the flanges being of sufficient strength so as not to yield to the pressure. While it was a comparatively safe device for lifting plates singly, it was not so secure when plates were lifted two at a time, as there was nothing to prevent one of the plates from slipping except friction, heightened by the pressure of the set screw. The clamp described was being used in lifting two plates, each weighing eight hundred pounds, when it gave way, allowing one of the plates to fall upon an employe, causing his death. In an action for damages the employer was held liable. An employer is not permitted to experiment at the risk of his employes. He must use the ordinary and recognized appliances, or know that those he does employ are reasonably safe for the purposes for which they are intended. This particular appliance had been seen by the employer in but one other place, and in making use of it he was held to have assumed any risks which were incident thereto. Johnson vs. Griffith Sprague Stevedoring Company, Supreme Court of Washington, 88 Pac. Rep. 193.

Obituary.

MR. C. S. HARWOOD, of the electrical department of the Denver, Col. Gas & Electric Company, died in Denver on February 4, at the age of 26.

MR. J. W. WHITE.—Mr. Joel W. White, well known for many years as the Superintendent of the Rhode Island Electric Protective Association of Providence, died recently after a long illness. He had been in poor health for a year, but his illness did not assume a dangerous form until a few weeks ago. Since that time his death had not been unexpected. Mr. White was born in Mystic, Conn., 53 years ago. Some 35 years ago he entered the employ of the Protective Association. His first position there was that of night watchman, and in a comparative short time he attained to the office of general manager of the association. When Mr. Henry A. Barker secured control of the concern, about 15 years ago, he became general manager, but the active direction of things was still in the hands of Mr. White, whose position from then until his death was superintendent.

Educational.

WINONA INSTITUTE.—The Winona-Indianapolis Technical Institute is enlarging its sphere and has added three new departments in the technical, namely: Civil, electrical and mechanical engineering. The Winona Assembly board has agreed to include the Winona Technical Institute in its support should any revenue be received from the operation of its electric lines. The same men who compose the board of Winona Technical Institute, have organized the Winona Interurban Railway Company, and are building 175 miles of electric lines from Peru to Goshen, from Ft. Wayne to Valparaiso and from Akron to Rochester. More than $3,000,000 will be invested in the bonds of the railway, and the entire stock will be held by its directors in trust for Winona Assembly, the profits of the railway to go to the support of the Winona technical schools at Winona and Indianapolis.

Personal.

MR. DELMER E. HAWKINS, formerly professor of political economy at Syracuse University, has been appointed assistant secretary of the Syracuse, N. Y., Lighting Commission.

MR. EDWARD P. COLEMAN has resigned as treasurer and manager of the Wetmore & Morse Granite Company to accept the position of general manager of the Great Northern Power Company of Duluth, Minn., beginning March 1.

MR. C. A. MOORE, president of Manning, Maxwell & Moore, has gone to Southern Europe for the object of taking a holiday of five or six weeks on an automobile trip.

MR. ALMON FOSTER, who was manager of the supply department of the Stanley-G. I. Electric Manufacturing Company in Boston for several years; and Mr. Chas. F. Southworth, formerly chief electrician for Swift & Co. in the East, have joined the forces of Wetmore-Savage Company, the electrical supply house of 66 Oliver Street, Boston.

MR. W. W. FREEMAN, vice-president of the Edison Electric Illuminating Company, of Brooklyn, N. Y., was slightly injured in the accident last week to the Pennsylvania "flier" from New York to Chicago, which jumped the track near Johnstown, Pa., and rolled 60 feet down the embankment into the Conemaugh River. His friends are congratulating him on such an extraordinary escape.

MR. JAMES PENNEFATHER has severed his connection with the Globe Electric Company, and has gone into business under his own name, with an office in the Knickerbocker Building, 116 West 39th Street, New York City. Mr. Pennefather recently purchased the theatre switchboard interests of the Chase-Shawmut Company, and stands ready to contract for the complete electrical equipment of theatres.

MR. FRED J. MILLER, after about twenty years on the editorial staff of the *American Machinist*, has retired from that well-known journal, to whose success and high reputation his efforts have contributed so conspicuously. He is to enjoy a spell of rest and recreation on his farm in Pennsylvania, but a variety of other work awaits his ripe experience and ability. Mr. F. A. Halsey, his associate, will continue with the *Machinist* as before.

MR. W. J. MULLIN.—Mr. William J. Mullin, who, on March 1, advances from assistant to the second vice-president to general traffic manager of the Delaware & Hudson Railroad, began his career with the Pennsylvania Railroad in 1887 as a telegraph operator. In one year he had become district passenger agent and in 1893 went to the Delaware & Hudson as Southern and Western agent in Philadelphia. In 1904 he was made industrial agent at Albany and in 1905 was advanced to his present position with charge of coal traffic.

PROF. M. NAMBA, professor of electrical engineering at Kyoto University, Japan, is on a visit of several months to this country, during which he will inspect some of the principal electrical manufacturing and generating plants. Prof. Namba is engineer of the Kyoto municipality in connection with the complete overhauling and extensive enlargement of its electric lighting, railway and power system, which will be commenced upon his return to Kyoto. Most of the equipment for the new plant will be purchased abroad.

MR. G. H. BARBOUR, whose article on wireless telegraph station construction appears on another page in this issue, was born in Akron, Ohio, 31 years ago. He received his education in the high-schools of New England and in Yale University, from which he graduated in the year 1896. He also spent one year in post-graduate work at Cornell. Since 1897 he has been engaged in engineering work in both mechanical and electrical lines. Mr. Barbour is a member of the American Society of Mechanical Engineers and of the New York Electrical Society. He has been connected with the De Forest Wireless Telegraph Company for the last five years as chief engineer, and during that time has erected many stations in this country as well as in England. He has frequently lectured on wireless telegraphy and allied subjects.

MR. MARTIN LOEWING has resigned his position as electrical inspector with the Louisiana Fire Prevention Bureau and has become engineer and general inspector for the Mutual Insurance Company, of New Orleans. The business of the company is exclusively with the lumber interests of the South. Mr. Loewing, on a recent trip to New York, was married in Brooklyn to Miss Viola Isabel Lund, and the honeymoon was spent at Atlantic City.

Business Notes.

THE LINK-BELT COMPANY has acquired a new office location at 84 State Street, Boston, from which the future business of its drive chain department in New England will be looked after.

AMERICAN CONDUIT COMPANY.—The American Conduit Company, manufacturer of bituminized fibre conduit, has moved its New York offices to 140 Nassau Street, to secure larger facilities and a more central location.

W. S. BARSTOW & COMPANY, engineers, of New York and Portland, Ore., have recently issued an announcement of the opening of a Montreal office in the Bank of Ottawa Building, which will be in charge of Mr. Robert S. Stangland.

THE HILL-WRIGHT ELECTRIC COMPANY, 105-107 Reade Street, New York, reports the signing of contracts for an aggregate purchase of two million burned-out lamps in 1907 and is looking for one million more. It is running night and day shifts and reports orders ahead for nearly 200,000 lamps.

THE WETMORE-SAVAGE COMPANY, 65 Oliver Street, Boston, Mass., has been obliged by the increase of its business to enlarge its quarters and has taken the entire building at 65-67 Oliver Street, consisting of five floors, which have been stocked with a complete line of electrical supplies.

THE ELECTRIC STORAGE BATTERY COMPANY announces that it has opened a sales office at Atlanta, Ga., located in Room 1126-27 Candler Building. It is under the charge of Mr. Harold H. Seaman, who was formerly engineer of the Cleveland sales office of the company. He will handle promptly all matters pertaining to the territory of Tennessee, North and South Carolina, Georgia, Florida, Alabama and Mississippi.

HARVARD UNIVERSITY is conducting an extensive series of laboratory tests on insulating materials and compounds. It has recently ordered from the Electric Cable Company, 17 Battery Place, New York, an amount of Voltax, the high-potential insulating compound, which during the past year has come into extensive use by the street railway companies in this country and abroad. The results of these tests will be watched with much interest by electrical engineers.

THE NEW YORK ELECTRIC CONTROLLER COMPANY, owing to the increased demand for its apparatus, has been compelled to extend its plant and will move to No. 35-37 Rose Street, in the early part of April, where it will be fully equipped with all the most modern machinery for turning out its motor starters and controllers. Up to the present time it has had great difficulty to fill its orders, which have been steadily increased ever since this apparatus has been placed on the market.

LIGHTING BULLETIN SIGNS.—Mr. C. Johnston Smith, general manager of the M. Wineburgh Advertising Co., 452 Fifth Ave., New York, has overcome the difficult problem of effectively illuminating bulletin signs by the use of Excello flaming arc lamps. A notable example of such an installation is the large sign at No. 48 West 34th St., 25 x 40 ft., which is very effectively lighted by only two Excello flaming arcs. The sign itself has created considerable attention. We understand that erection and maintenance cost compare very favorably with the use of ordinary methods. Particulars about flaming arcs suitable for such installations may be obtained from the Excello Arc Lamp Company, 24 East 21st St., New York.

CHICAGO FUSE WIRE.—Mr. W. W. Merrill, secretary of the Chicago Fuse Wire & Mfg. Company, 170 South Clinton Street, Chicago, states that some few weeks ago it secured the services of Mr. J. J. Schaller to represent it as travelling representative through the Western, Southern and Central States, with headquarters in Chicago. Mr. Schaller has had several years of valuable experience in the electrical field as salesman for large jobbing houses, namely, Albert Smith, Milwaukee; Manhattan Electrical Supply Company, Chicago, and American Electrical Supply Company, Chicago. He has already met with success in his new position and his connection with the Chicago Fuse Wire & Manufacturing Company will result in increased popularity of its well-known products, such as "Union" enclosed fuses and blocks, "Union" switch and conduit boxes, tested fuse wire and links, telephone fuses and blocks. The Chicago Fuse Wire & Mfg. Company announces that it has discontinued its St. Louis office, Mr. G. A. Knoche, who has been its representative in the southwest, having resigned its agency to accept a position immediately with the National Metal Molding Company in charge of its New York office. Mr. Knoche has been representing several companies in the southwest with headquarters at St. Louis, and met with marked success. Mr. Merrill states that all territory formerly covered by Mr. Knoche will be taken care of from Chicago office.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Electrochemical Society. Secretary, S. S. Sadtler, 59 S. 10th St., Philadelphia. Next meeting Philadelphia, May 2, 3 and 4, 1907.

American Institute of Electrical Engineers Secretary, Ralph W. Pope, 95 Liberty St., New York. Meetings, fourth Friday of each month.

American Street and Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, 12 West 31st St., New York. Spring meeting, Indianapolis, Ind., May, 1907.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y. Next meeting Detroit, Mich., third Wednesday, September, 1907.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies' Building, 39th St., New York.

Association of Edison Illuminating Companies. Secretary, George R. Stetson, New Bedford, Mass.

Association of Electric Lighting Engineers of New England. Secretary, Welles E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting Atlantic City, N. J., June 19, 1907.

California Independent Telephone Association. Secretary, P. T. Whittier, Spencer, Cal.

Canadian Electrical Association. Secretary, T. S. Young, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W. Toronto, Ont.

Central Electric Railway Association. Secretary, W. F. Mulholland, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, John F. Dostal, 405 17th St., Denver, Col. Next meeting, September, 1907.

Electric Club of Cleveland. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary-Treasurer, Geo. H. Erich, 401 Monadnock Block, Chicago.

Electrical Trades Association of Canada. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliot, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas and Electrical Association. Secretary, R. A. Davidson, 58 William St., New York. Next meeting, November, 1907.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, Dr. Arthur H. Elliot, 4 Irving Place, New York. Meetings in New York, second Friday of each month.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Norfolk, Va.

Iowa Electrical Association. Secretary, L. B. Spinney, Iowa State College, Ames, Ia. Next meeting, Clinton, Ia., April 18 and 19, 1907.

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone Ia. Next meeting, Sioux City, Ia., March 12-14, 1907.

Iowa Street and Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Clinton, Ia., May, 1907.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Topeka, Kan., October 16, 1907.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Houck McHenry, Jefferson City, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. C. L. Eglin, Philadelphia, Pa.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y. Next meeting, New York City, July 17, 18 and 19, 1907.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next annual meeting, Chicago, second Thursday in June, 1907.

NATIONAL-INTERSTATE TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y. Next meeting, Syracuse, N. Y., June, 1907.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1908.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, O. Next meeting, Toledo, Aug. 20-22, 1907.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, O. Next meeting, Columbus, O., last Thursday in April, 1907.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Ballard, 104 Canal St., Cleveland, O.

OLD TIME TELEGRAPHERS AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls, N. Y., 1907.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings second Saturday of each month.

PUBLIC UTILITIES ASSOCIATION OF INDIANA. Secretary, J. A. Shunk, Peru, Ind. Regular meetings second Thursday in May and December.

SOUTH DAKOTA TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, R. B. Stichter, Dallas, Tex. Next meeting, San Antonio, Tex., May 14-16, 1907.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass. Next meeting, March, 1907.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Wednesday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEB. 19, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

844,352. CONTROLLER FOR ELECTRIC MOTORS. Harry U. Hart, LeHavre, France. App. filed June 12, 1905. Mechanical construction of train controller, together with diagram of circuits therefor by which one or more braking notches will be serviceable when the reverse switch occupies either forward or reverse relation.

844,353. CIRCUIT BREAKER. Frank O. Hartman, Mansfield, O. App. filed Feb. 25, 1904. A type of oil bath switch having submerged copper plates engaged by a downwardly movable U-shaped brush or shoe. The latter is tripped to move downwardly by a solenoid and detent.

844,354. PULLING BOX FOR CONDUITS. Andrew Hawkinson, St. Paul, Minn. App. filed Dec. 11, 1905. Conduit connector having an enlarged pipe section with conically threaded ends and an internal double threaded sleeve at one end by which the conduit section is assembled on the usual pipes.

844,361. ELECTRIC ARC LAMP. Franz Janecek, Karlin, near Prague, Austria-Hungary. App. filed Nov. 22, 1905. An electric arc lamp of that type having a pair of carbons depending toward one another in a V-shape. The feed is operated by the heat of the arc.

844,379. ELECTRIC CONTROLLER. Edwin Marshall, Warrensburg, Mo. App. filed May 29, 1906. A form of rheostat or controller for dentists in which the resistance element is in the form of spirally or zig-zag arranged plates and the heat therefrom is utilized to warm a supply of compressed air.

844,383. ELECTRIC MOTOR. Charles R. Meston and Herbert I. Finch, St. Louis, Mo. App. filed Apr. 11, 1906. The armature of the motor includes a form of positive clutch having locking pins and centrifugal means whereby the clutch is not engaged until the motor is properly running.

844,384. ELECTRIC MOTOR. Charles R. Meston and Herbert I. Finch, St. Louis, Mo. App. filed Apr. 11, 1906. Relates to modifications of the same.

844,406. ELECTRIC TRIMMING APPARATUS. Felix J. Rush, New York, N. Y. App. filed Sept. 16, 1905. Has a rotary shaft with a trimming device and guard carried thereby, the parts of which converge into a piercing point. An electric current is passed through the trimming device to heat the same.

844,436. METERING AND CONTROLLING SYSTEM FOR ELECTRIC CIRCUITS. James I. Wood, Fort Wayne, Ind. App. filed Sept. 12, 1905. A meter of that class in which the lamp circuit is opened after a predetermined energy has been used and which is coin controlled. The patentee has a standard type of switch and adapts it for different capacities by having it receive only a predetermined percentage of the energy consumed in the customer's circuit.

844,439. ARC LAMP. John H. Bennett and Adrian I. Miner, San Francisco, Cal. App. filed June 3, 1905. A form of enclosed arc having a two-part carbon clutch of magnetic material within a tube, a current carrying coil surrounding the tube, and magnetic strips for completing the magnetic circuit to the clutch parts.

844,455. MEANS FOR CONVERTING MOTION AND HOUSING THEREFOR. Charles J. Klein, New York, N. Y. App. filed Sept. 25, 1905. A pendent snap switch having a pair of buttons for opening and closing the circuit. A pair of spring impelled plungers or detents control the motion so as to make it abrupt for opening and closing the circuit.

844,506. TELEPHONE TRUNKING SYSTEM. Francis W. Dunbar, Chicago, Ill. App. filed Aug. 6, 1902. Relates to a complete diagram of circuits for a trunking exchange system.

844,533. ELECTRIC LIGHT SWITCH. James McGavick, Denver, Colo. App. filed Apr. 6, 1906. A snap switch adapted to be inset in a wall or surface and having a spring propelled switch blade which is temporarily restrained and compelled to move abruptly by lost motion connection with the impelling arms.

844,572. ELECTRIC BELT. Richard Wingren, Burlington, Kan. App. filed Oct. 5, 1905. A form of switch adapted to control the circuits of an electric belt worm for medical purposes.

844,578. SPARK COIL. John F. Cavanagh, Providence, R. I. App. filed Sept. 28, 1905. Details of construction of spark coil enclosed in a wooden block or casing and embedded in paraffine or insulating material.

844,605. ELECTRIC LIGHTING DEVICE FOR LAMPS AND OIL STOVES. Svend M. Meyer, New York, N. Y. App. filed Mar. 20, 1905. An attachment for lamps and oil stoves having a wick tube. Has a bi-metallic thermal arm of zig-zag form and an incandescing coil, the circuit of which is opened and closed by the thermal arm.

844,610. ELECTRIC CIGAR LIGHTING APPARATUS. Svend M. Meyer, New York, N. Y. App. filed Dec. 21, 1905. A form of electric torch having circuit wires which lead in through the handle and a capillary body which is adapted to be impregnated with the hydro-carbon fluid, and which has resistance elements by which the fluid is ignited.

844,611. ELECTRIC LIGHTING APPARATUS FOR INCANDESCENT AND OTHER GAS LAMPS. Svend M. Meyer, New York, N. Y. App. filed Mar. 10, 1906. Has a valve with separate link connections to a pair of separate electro-magnets one of which operates to open the valve, while the other operates to close it. Has an incandescing coil for igniting the gas and means for cutting the coil out of action.

844,630. SPEED CONTROLLER FOR ELECTRIC MOTORS. Robert Temple, Denver, Colo. App. filed Apr. 24, 1906. A speed controller comprising separated insulating plates provided with spaced contact devices and a rotatable arm mounted between the plates, said arm being provided with correspondingly spaced contact coils arranged in pairs and provided with a coiled spring for holding the coils against the plates.

844,635. CARBON BALL TRANSMITTER. Kelley M. Turner, New York, N. Y. And Norton W. Johnston, Chappaqua, N. Y. App. filed Sept. 8, 1905. Covers the use of small carbon balls in a telephone transmitter. Patentee claims a block having cavities, a carbon diaphragm and carbon balls of substantially half a millimeter in diameter.

844,650. ALTERNATING-CURRENT RETAINING DEVICE FOR ELECTRIC MOTOR CONTROLLERS. Thomas E. Barnum, Milwaukee, Wis. App. filed Nov. 2, 1903. A starting switch having an alternating-current retaining magnet.

844,651. DRUM CONTROLLER FOR ELECTRIC MOTORS. Thomas E. Barnum, Milwaukee, Wis. App. filed Nov. 9, 1903. Has terminals adapted to be engaged by the contacts of a drum, one set connected to the armature resistance and the other set to the field resistance, the two sets being in different axial planes.

844,652. THREE-WIRE REVERSIBLE DRUM CONTROLLER. Thomas E. Barnum, Milwaukee, Wis. App. filed Oct. 3, 1904. Relates to modifications of the above.

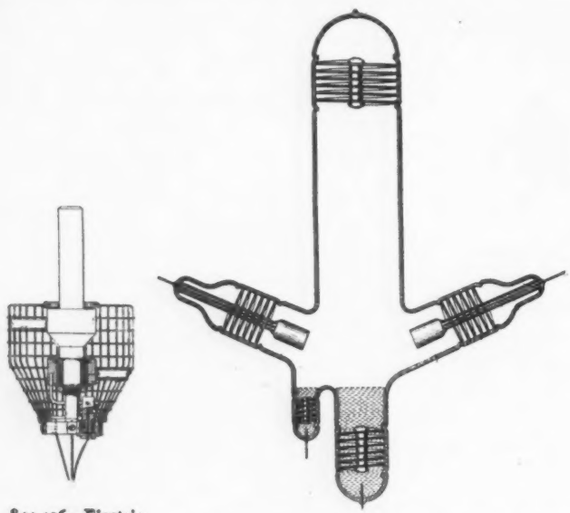
844,661. CLUTCH CONTROLLED ELEVATOR. Henry H. Cutler, Milwaukee, Wis. App. filed Dec. 21, 1903. Has a continuously operating motor and a magnetic clutch, a brake and solenoids therefor, and a controller and limit switch for operating the brake and clutch.

844,662. ELECTRICALLY CONTROLLED SKIP HOIST. Henry H. Cutler, Milwaukee, Wis. App. filed July 20, 1904. Modifications of above adapted to hoisting apparatus.

844,663. SELF-STARTER FOR ELECTRIC MOTORS. Henry H. Cutler, Milwaukee, Wis. App. filed May 12, 1905. Contactors each of which closes circuit to operate succeeding. as a series relay and a time relay for arresting the progressive operation of the contactor magnets.

844,701. ELECTRIC MOTOR. Julius B. Wantz, Chicago, Ill. App. filed Feb. 23, 1906. Has a ratchet on the motor shaft and a dog co-operating therewith so as to tension a spring switch in the operation of the motor, so as to abruptly break the shunt circuit of the motor.

844,722. RECEIVER SUPPORT. John Heisch, Jr. Allegheny, Pa.



844,406—Electric Trimming Apparatus

844,779—Protective Device for Frangible Vessels.

App. filed Dec. 11, 1906. Phone having an adjustable bracket to carry the receiver in spring supported relation to the ear of the person using the phone. The bracket is adjustable so that the receiver may be placed either on the left or the right-hand side.

844,731. SELF-LIGHTING ATTACHMENT FOR LAMPS. Svend M. Meyer, New York, N. Y. App. filed Nov. 18, 1904. An electric attachment for igniting kerosene in oil lamps having a wick. The lamp has a spirally wound element which carries at its end an incandescing element of iridium. The heat of the lamp causes the coil to unwind so as to separate the iridium element from its contact connection.

844,755. VENT VALVE FOR BATTERIES. Frank J. Schalow, New York, N. Y. App. filed Sept. 28, 1906. A screw threaded plug adapted for use with automobile storage batteries. Has a central needle valve which is normally held in closed relation by an elastic band in the manner of a safety valve.

844,777. CONTROL SYSTEM FOR CONNECTING MOTORS AS BRAKING GENERATORS. Frank E. Case, Schenectady, N. Y. App. filed June 6, 1906. Complete control system for train motors having contactors and a reversing switch and circuits by which the motor is connected to exert magnetic braking effect when desired.

844,779. PROTECTIVE DEVICE FOR FRANGIBLE VESSELS. William Constable, Schenectady, N. Y. App. filed Oct. 31, 1904. In order to prevent dangerous shocks of mercury in vacuum tubes during their transportation, patentee has the walls of the vessel with helicoidal surfaces for absorbing the shock due to the movement of the fluid.

844,787. ELECTRIC SWITCH. Charles E. Eveleth, Schenectady, N. Y. App. filed June 23, 1903. Switch contact comprising homogeneous mixture of carbon and carborumdum.

844,791. COMBINED FUSE AND SWITCH. Henry Geisenhoner, Schenectady, N. Y. App. filed July 14, 1904. The switch blade or arm is hollow and contains a spring tensioned fuse so that the blade is tripped to open the circuit when the fuse blows.

844,792. MECHANICAL EAR FOR TROLLEY WIRES. Edward E. Gilmore, Philadelphia, Pa. App. filed Jan. 13, 1906. The trolley wire or conductor is longitudinally recessed with a pair of lateral grooves and these grooves are engaged by depending plates with projecting ribs thereon, which are clamped into the grooves by a conical wedge.

844,796. INSULATING WIRE HOLDER. Andrew Hatchett, Louisville, Ky. App. filed Nov. 13, 1905. An insulating block has a spirally cut groove into which the line wire is passed.

844,797. BLOCK SIGNAL SYSTEM. Laurence A. Hawkins, Schenectady, N. Y. App. filed July 21, 1905. Block signal system having direct current charged track sections. Has a single semaphore arm movable into danger and caution postions, and track relays having circuits so connected as to secure the overlap feature.

844,800. SYSTEM FOR CONTROLLING ELECTRIC SWITCHES. Edward M. Hewlett and Charles C. Eveleth, Schenectady, N. Y. App. filed May 12, 1903. Has a trip device for each circuit breaker of the set and circuit connections and locking devices by which all the other trip devices are restrained from actuation when any one operates.

844,810. METHOD OF INCREASING THE EFFICIENCY OF ALTERNATING CURRENTS. Isidor Kitsee, Philadelphia, Pa. App. filed July 11, 1903. Divides the cycles of the alternating current between the primaries of separate transformers, and impels the impulses of the secondaries of each to flow through a consumating circuit.

844,811. TELEPHONY. Isidor Kitsee, Philadelphia, Pa. App. filed Oct. 14, 1905. Relates to single party line having a magnet resistance adapted to be shunted by the hook and a visual signal controlled by said magnet.

844,815. STORAGE BATTERY. Simon Lake, Bridgeport, Conn. App. filed May 26, 1904. Has an inner tank and outer tank separated by infusible material and a filling of waterproof fusible material which melts at predetermined temperature.

844,829. INCENDESCENT LAMP SOCKET. Johann G. Peterson, Bridgeport, Conn. App. filed July 5, 1906. A form of embossed fastening between the two parts of the casing of a sheet metal lamp socket. The parts have embossed ridges and spring tongues which prevent their disengagement without special manipulation.

844,839. TELEPHONE ATTACHMENT. William R. Whitehorne, Bethlehem, Pa. App. filed Sept. 19, 1906. A device to produce an audible sound in the receiver of a telephone when off its hook operable from any station so as to call when line is being held.

844,849. PROCESS FOR PRODUCING MANTLES FOR INCANDESCENT GAS LIGHTING. Joseph A. E. H. Boullier, Paris, France. App. filed March 23, 1903. The process of manufacturing incandescent mantles from micro-cellulose which consists in subjecting nitro-cellulose filaments to commercial incandescing nitrates so as to cause them to swell without dissolution and then impregnating them with incandescing compounds.

844,878. MEANS TO INCREASE THE EFFICIENCY OF ALTERNATING CURRENTS. Isidor Kitsee, Philadelphia, Pa. App. filed June 13, 1905. Relates to modifications of No. 844,810.

844,918. CAR MAGNET SUPPORT. William M. Brown, Johnstown, Pa. App. filed Jan. 25, 1906. Relates to railways in which the track sections are temporarily electrified during the passage of the train by depending electro-magnets thereon. Present patent relates to method of supporting these electro-magnets between the trucks of different cars so that their action will be continuous during the passage of the whole train.

844,923. AUTOMATIC SHUT-OFF FOR FLUIDS. Edmund L. Cridge, Passaic, N. J. App. filed Feb. 16, 1906. Magnet operated valve for an air compressor system in which the magnet trips a detent to release a small valve device which admits the air to a piston so as to open or close the main valve.

844,934. TRAP FOR PREVENTING THE BURGLARIZING OF IRON SAFES. Shedrick M. Harden, Chicago, Ill. App. filed June 6, 1905. The hallway of a bank building is designed to be provided with trap doors to cause the fall of burglars therein and electrical devices operate an alarm bell.

844,949. SANITARY MOUTHPIECE GUARD. Robert R. MacGill, Baltimore, Md. App. filed Apr. 26, 1906. Has a cylindrical housing for a roll of paper which is drawn outward to cover the transmitter whenever desired. Whole frame detachable on transmitter mouthpiece.

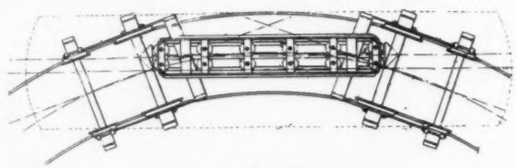
844,961. CIRCUIT BREAKER FOR ELECTRICAL CONDUCTORS. William C. Shaw, White Plains, Md. App. filed Aug. 2, 1906. The circuit breaking parts are revoluble in aligned relation and each has a cam so that any rotary movement causes the separation of the parts to break the circuit.

844,979. ELECTRIC HEATER. Edwin R. Waterman, San Francisco, Cal. App. filed Feb. 15, 1904. A cylindrical tank, has its wall lined with plastic material containing resistance element, and inner casing has inlet and outlet water connections.

844,991. PORTABLE DYNAMO. George A. Allen, Western Springs, Ill. App. filed Dec. 3, 1906. Mechanical construction of blasting dynamo having a pull rod with rack which rotates the dynamo armature through pinion connection.

844,997. PHASE SPLITTER AND CLUTCH. Henry H. Cutler, Milwaukee, Wis. App. filed Aug. 7, 1905. The combination with a motor, of a phase-splitter, comprising a plurality of resistance of different character, a magnetic clutch mechanism, and a plurality of switches actuatable consecutively for controlling said resistances and said clutch.

845,010. ELECTRICAL PROTECTIVE APPARATUS. Charles A. Rolfe, Rochester, N. Y. App. filed Feb. 4, 1905. Combined lightning arrester and thermal cut-out having small graphite resistances with solder held dents which release spring contact blades.



444,918—Car Magnet Support.

845,016. APPARATUS FOR AERATING AND CLEANING FLOUR, GRITS, AND THE LIKE. Carl Trettau, Gimmel, Germany. App. filed Nov. 2, 1906. A device for purifying flour of the various living organisms which infect it. Patentee makes use of electric arc lamps into which the impurities are designed to fall and be destroyed while the flour is at the same time cleansed and purified by a blast of air.

845,017. APPARATUS FOR IMPROVING GRAIN. Carl Trettau, Gimmel, Germany. App. filed Nov. 2, 1906. Relates to modifications of the above.

845,023. SYSTEM OF CONTROL. Harold E. White and Harold C. Pease, Schenectady, N. Y. App. filed June 26, 1905. System of control having a governing relay in a pilot circuit, a master controlled therefor, and a shunt which is bridged across the contacts of the master controller when said relay operates.

845,024. CONTROLLER. Harold E. White, Schenectady, N. Y. App. filed June 6, 1906. Details of controller having resistance coils in box, and arm to cut them out successively. Also large circuit breaking magnet.

845,034. SAFETY DEVICE FOR OVERHEAD ELECTRIC CONDUCTORS. Emile Giraud, Paris, France. App. filed Mar. 6, 1906. Device for interrupting current connection to overhead conductor when wire breaks.